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New evidence on accelerator performance based on funding and location

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Evidence on
 accelerator
 performance

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Received 23 October 2017
 Revised 12 July 2018
 26 March 2019
 22 October 2019
 18 January 2020
 Accepted 19 January 2020

Abstract

Purpose – Seed accelerators (SAs) appear as a more advanced version of business incubators. These for-profit organizations in exchange of equity, help setting new start-ups by providing mentoring and funding during its first months. Due to their emergent nature, the impact and expectations of SAs remains largely unknown. Therefore, the purpose of this study is to throw new light on this field by empirically assessing for the first time the performance and prospects of these organizations through a survey of 116 SAs.

Design/methodology/approach – A model based on the Business Incubators literature is built with four categories covering size, location, age and profitability variables, leading to two hypotheses to be tested empirically over a survey of 116 SAs.

Findings – Some remarkable findings arise after implementation of both bivariate and multivariate analysis. The results confirm a higher size and performance in the US and in the oldest SAs at statistically significant levels.

Research limitations/implications – The study is not free from limitations but the findings make a contribution to the still scarce existing literature on SAs, and provide some managerial implications to their stockholders, to investors and to entrepreneurs.

Practical implications – The findings concerning performance indicators are especially helpful for investors, primarily concerned with the percentage return on investment factor, the period and the investment rounds needed to achieve exit. Another key issue is the SA's role as an employment seedbed. At first glance, the amount of employment, both overall and per company, might seem small given the young age of these firms. The impact of SAs on the generation of new employment is difficult to measure as it usually takes place in further stages of development of the tenant companies, the so-called scale-up process. Nonetheless, at present, the number of new companies being born is remarkable and, in terms of employment, the results are indeed promising. Our findings also offer important implications for entrepreneurs, venture investors and policy-makers. To entrepreneurs, our findings offer insight on the expectations to hold in the accelerator programs.

Social implications – For policy-makers and would-be accelerator founders, our results support the idea shared in the literature that accelerators can be an effective entrepreneurial intervention, even in small entrepreneurial ecosystems, compared to the strongest entrepreneurial hubs (Hallen *et al.*, 2017).

Originality/value – SAs are a very recent phenomenon which is blooming all over the world, especially in developed countries. SAs are therefore considered a key agent in the prospects of any entrepreneurial ecosystem. However, no studies have so far analysed the impact and performance of this emerging instrument. This is precisely the main purpose of this paper, to offer for the first time an approximate and exploratory assessment on the impact and prospects of SAs, based on a database.

Keywords Performance, Innovation, Start-ups, Entrepreneurship, Business incubator, Seed accelerator

Paper type Research paper



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European Journal of Management
 and Business Economics
 Vol. 29 No. 3, 2020
 pp. 217-234
 Emerald Publishing Limited
 e-ISSN: 2444-8494
 p-ISSN: 2444-8451
 DOI 10.1108/EJMBE-10-2017-0029

1. Introduction

Since emerging in Silicon Valley in the late 1990s, seed accelerators (SAs) have evolved into a new model for incubating technology start-ups, specialising in the software and Internet industry. Today, more than 200 seed accelerator programmes (SAPs) operate in the United States and over 300 operate in Europe. SAPs are also spreading rapidly elsewhere around the world.

Most SAPs were launched after the financial crisis in late 2007, and the number of new accelerators in Europe increased by nearly 400% from 2008 to 2013. This increase reflects an impressive counter-cyclical appearance of start-up initiatives across the continent (Salido *et al.*, 2014).

An SA is usually described as a new type of early-stage development programme for start-ups that combines elements of traditional business incubators (BIs) with equity-based funding and in-depth mentoring. Different versions have rapidly spread, with names such as micro-seed funds, business growth accelerators and boot camp programmes.

An SA is typically an independent, private organisation that aims at creating scalable and viable businesses in just a few months by connecting founding teams with a broad pool of experts and investors. Thus, SAs can be viewed as a more advanced version of BIs (Pauwels *et al.*, 2016). The expectation is that SAs enhance the innovative capacity and development of a region by matching promising businesses with investors. In developed countries, particularly the United States, SAs and BIs take the lead in promoting the birth of new companies, generating skilled employment and encouraging technology transfer.

Born in the United States, SAs have become a key component of entrepreneurial ecosystems worldwide. Most start-up founders are eager to enrol in SAPs, which they view as useful channels to increase their chances of attracting external investment and boost their start-up's visibility and perceived viability.

Although SAs have rapidly become a global phenomenon, their performance and effectiveness are still insufficiently studied because of their newness and the lack of comparative analysis of their key aspects. This study bridges this gap by offering an initial appraisal of the key indicators of SA performance using a comparative approach. More specifically, the main objectives of this study are: (1) to identify specific key performance indicators of SAs; (2) to determine the factors that are most closely linked to these key performance indicators; (3) to determine the extent to which US SAs are the leading SAs worldwide and identify their main advantages, if any, over non-US SAs; and (4) to provide an overview of the performance of a group of representative SAs from the time of their emergence to mid-2018.

The extent and scope of these objectives can be better understood through the following research questions: (1) Which variables and attributes best explain the effectiveness and prospects of SAs? (2) What is the initial performance of SAs in terms of the indicators that are most highly valued by promoters and users? (3) What are the critical variables and attributes that SAs should prioritise to meet their goals more effectively? (4) What is the record of a global group of SAs in terms of their key performance indicators?

The few studies that have examined SAs have tended to target accelerated firms (Gonzalez-Uribe and Leatherbee, 2017; Stayton and Mangematin, 2019). Although new ventures are a key part of understanding the impact of SAPs, they are insufficient on their own to properly quantify the effectiveness of an SA in terms of its business and social impact. Therefore, an empirical study such as the present one, which focuses on the initial performance of SAs, makes a valuable contribution to the literature by exploring the impact and prospects of SAs. The results of the study have key implications for both SA managers and SA promoters.

This research identifies performance trends and initial outcomes of the SA phenomenon. Although the study relies on some variables and measures that are covered in the BI literature, new variables that are especially valuable for SAs are introduced and assessed.

This empirical study is based on a data set of 116 SAs located in the United States and elsewhere between 1997 and 2014. Data were collected from retrospective and real-time sources including website visits, accelerators, start-up websites, blogs, LinkedIn profiles, trade publications and funding databases such as crunchbase and Seed-DB. Collecting data from multiple sources improves the reliability and credibility of results (Yin, 2009).

The paper is structured as follows. The literature on BIs is first reviewed in search of an appropriate definition of SAs, followed by a review of empirical studies of BI and SA performance. The hypotheses are also stated. Next, the model and method are described. The empirical results section then presents the results of bivariate and multivariate analyses of the data, and the following section discusses these results. The final section describes the findings and managerial and scholarly implications, concluding with the limitations of this study and highlighting important issues for further research.

2. Literature review

2.1 *From business incubators to seed accelerators*

BIs first appeared in the 1980s and underwent rapid growth until the late 1990s. During this period in Europe, most BIs were integrated into the European BIC network. However, this growth slowed in the years following the burst of the internet bubble in 2000/2001. Simultaneously, a new form of BI, the SA, emerged as an important springboard for local entrepreneurs. SAs support the generation and growth of innovative technology-based firms, specialising in software- and Internet-related businesses.

New BI models providing investment and assistance in pre-seed stages have emerged and blossomed in recent years, first in the United States. These models then spread to Europe before rapidly expanding to other parts of the world. This new generation of BIs aims to help and accelerate the creation of innovative companies, from the conception of the initial idea to its initial stages in the market. To do so, these new BIs began providing important business assistance, resources, funding and networking opportunities, and they soon came to be known as SAs or SAPs. These SAPs are described as fast-track processes for new venture development, and they are offered in return for a percentage of equity in the newly established company. The return on investment and profits are made when the SA sells its shares to other investors through exit operations.

The definition of an SA amongst practitioners remains inconsistent. Some BIs refer to themselves as SAs, capitalising on the current hype surrounding SAs. In contrast, others that meet the formal definition of an SA still refer to themselves as BIs (Hochberg, 2016). Although SAs were conceived with the same business structure and philosophy as BIs, some significant differences have emerged. Thus, an SA does indeed follow a specific organisational model in its own right.

The majority of SAs provide an initial seed investment in exchange for accommodation and services (Bliemel *et al.*, 2016; Pauwels *et al.*, 2016). Dempwolf *et al.* (2014) describe four subtypes of accelerators: innovation, social, university and corporate. All of these accelerators are consistent with Cohen and Hochberg's (2014) definition. Innovation accelerators are the best-known form of SAs. Examples include Techstars and Y-Combinator. Innovation accelerators are still the most widespread kinds of accelerators. Social accelerators have been gaining increasing acceptance since the launch of social entrepreneurship programmes such as the Global Social Venture Competition. Some universities back entrepreneurship programmes linked to hosting entrepreneurs at their own accelerator facilities (Shah and Pahnke, 2014). Finally, corporate accelerators have emerged since 2014 to provide corporations with their own innovation ecosystems in pursuit of the goal of acquiring client start-ups (Page and Garbuio, 2016).

SAs can be described as a more advanced version of BIs (Pauwels *et al.*, 2016). They usually launch an open application process where anyone with a business idea can apply. The best projects are then chosen and enrolled in an SAP. The programme culminates with the presentation of the most successful projects to investors in a public pitch event known as “demo day” (Figure 1).

2.2 Accelerator performance indicators

There has been limited research on accelerators, primarily because of the newness of the phenomenon and limited data availability (Stayton and Mangematin, 2019). Challenges in finding data are considerable and affect researchers’ ability to conduct rigorous empirical analyses and performance evaluations. Accelerators have quickly proliferated, but there is a general absence of large-scale representative public databases covering accelerator programmes. This lack of such databases prevents researchers from evaluating the impact of these programmes (Hochberg, 2016).

As Cohen and Hochberg (2014) noted, the scarcity of studies on the performance of accelerators makes it unclear how effective they are. Indeed, little research has explored, even at a descriptive level, the effectiveness of SAPs or the reasons for better or worse results. The measures that should be used to quantify the effectiveness and success of these initiatives are not yet clear.

Much of the limited research on accelerators to date falls into one of the following four categories: (1) conceptual descriptions of the accelerator model (Cohen and Hochberg, 2014; Dempwolf *et al.*, 2014; Hochberg (2016); (2) qualitative assessment of how accelerators may serve to accelerate start-ups (Radojevich-Kelley and Hoffman, 2012; Cohen, 2013; Pauwels *et al.*, 2016; Cohen *et al.*, 2018); (3) empirical studies to assess whether accelerators positively affect the outcomes of the companies that participate in their programmes (Smith and Hannigan, 2015; Cohen *et al.*, 2019; Fehder and Hochberg, 2019; Hallen *et al.*, 2019); and (4) empirical studies to assess whether accelerators have a negative or inconclusive effect on the outcomes of accelerated start-ups (Smith *et al.*, 2013; Gonzalez-Uribe and Leatherbee, 2017; Yu, 2019). Table 1 summarises accelerator studies in terms of the perspective, focus of the study and main findings.

Accelerators have attracted the attention of researchers because they provide a window into early-stage entrepreneurship, which has historically been difficult to observe (Aldrich and Yang, 2012). However, the existing research is highly fragmented and has yet to form into a robust corpus of knowledge built around a core framework with a shared understanding of questions, methodologies and knowledge gaps (Cohen *et al.*, 2019).

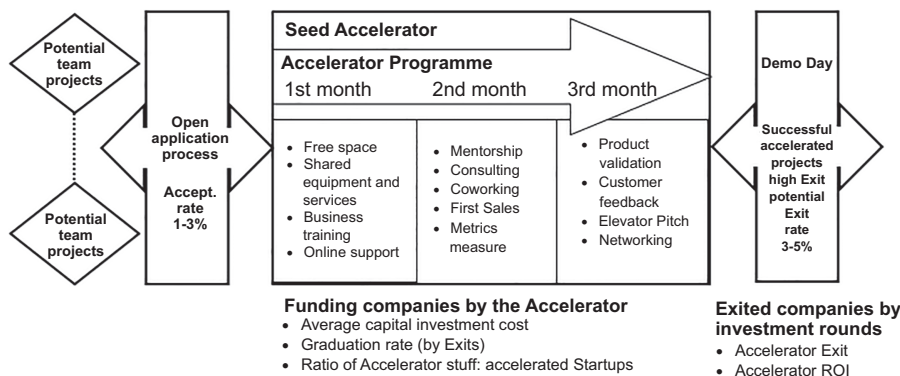


Figure 1. Seed Accelerator Programme (Pauwels *et al.*, 2016)

Authors	Dependent variable/ research focus	Method	Data	Summary and findings
<i>(1) Conceptual descriptions of the accelerator model</i>				
Cohen and Hochberg (2014)	Accelerator model definition	Conceptual		Differences between accelerators, incubators, angel investors and coworking environments. Success factors
Dempwolf <i>et al.</i> (2014)	Accelerator performance assessment	Conceptual		Taxonomy of innovation accelerator: (1) incubators and venture development organisations, (2) proof-of-concept centres and (3) accelerators
Hochberg (2016)	Accelerator model definition	Conceptual		Evidence on the effects of the accelerator models on the regional entrepreneurial environment
<i>(2) Qualitative analyses assessing accelerator performance</i>				
Kim and Wagman (2014)	(1) Accelerator portfolio size choice; (2) Profit-maximising portfolio size; (3) Entrepreneurial effort effects; (4) Accelerator disclosures; (5) Accelerator portfolio quality; (6) Accelerator exit time	Qualitative		Game theory model of the accelerator as certification of start-up quality. Accelerator may possess incentives to exit its portfolio firms early
Radojevich-Kelley and Hoffman (2012)	Accelerator model and start-ups: (1) Motivations; (2) Success rates; (3) Selection criteria; (4) Challenges; (5) Added value	Qualitative	5 US accelerators	Exploratory case study examining how accelerator programs connect start-ups with potential investors
Cohen (2013)	Accelerators organisational learning	Qualitative	70 interviews from 9 US accelerators	Embedded multiple-case study to assess how the new venture process is accelerated
Pauwels <i>et al.</i> (2016)	Design elements : (1) Program; Strategy; (2) Selection; (3) Funding; Alumni	Qualitative	13 European accelerators	Accelerator model's key design parameters
Cohen, Bingham and Hallen (2018)	Accelerators' choices: (1) Consultation intensity ; (2) Disclosure level; (3) Extent of customisation	Qualitative	8 US accelerators and 37 accelerated start-ups	Inductive multiple-case study on how accelerator programs influence new ventures' ability to survive and grow
Stayton and Mangematin (2019)	Venture characteristics: (1) Survival; (2) Resource network; (3) Accelerator's resources	Qualitative	4 clean tech start-ups	Explores the mechanisms by which accelerator programs assist nascent technology ventures to minimise start-up time

*(continued)***Table 1.**
Accelerators studies

Authors	Dependent variable/ research focus	Method	Data	Summary and findings
<i>(3) Empirical studies of accelerators, establishing a new performance framework or studying the positive effect on the outcomes of accelerated start-ups</i>				
Smith and Hannigan (2015)	1) Time of exit; 2) Subsequent funding outcomes	Quantitative	619 US start-ups	Study based on 2 top accelerators (Y Combinator and Tech Stars) for the period 2005–2011. Participation in a top accelerator program increases the speed of exit by acquisition and by quitting
Cohen, Fehder, Hochberg and Murray (2019)	(1) Founder background; (2) Sponsor type; (3) Accelerated start-up raised funding post-program > \$500 K; (4) Total \$ funding raised; (5) Maximum valuation attained	Quantitative and qualitative	146 US accelerators and 100 interviews	Descriptive correlations between design elements and performance of the start-ups that attend the Accelerator programs
Fehder and Hochberg (2019)	(1) Accelerator year foundation; (2) MSA location	Quantitative	59 US accelerators	Impact of an accelerator's arrival on the volume of seed and early-stage VC deals completed in the region
Hallen, Bingham and Cohen (2019)	(1) Accelerated start-up outcomes; (2) Time to fundraising; (3) Start-up learning process; (4) Consultation in focal Accelerators; (5) Inter-organisational learning mechanisms	Quantitative and qualitative	8 US accelerators and 70 interviews	Comparison of treated and untreated start-ups on a variety of outcomes
This study	(1) Accelerator investment rounds in accelerated start-ups; (2) Location effect	Quantitative	116 worldwide accelerators	Model exploring accelerator performance on three axes: (1) size, (2) location and age and (3) profitability variables. Higher size and performance in the United States and in the eldest accelerators
<i>(4) Empirical studies of accelerators' negative or inconclusive effect on the outcomes of accelerated start-ups</i>				
Smith, Hannigan and Gasiorowski (2013)	(1) Accelerated start-ups survival; (2) Funding; (3) Founder background	Quantitative	740 accelerated start-ups	Analysis of differences in the founder backgrounds in two top accelerators (Y Combinator and TechStars) compared to other start-ups

Table 1.

(continued)

Authors	Dependent variable/ research focus	Method	Data	Summary and findings
Gonzalez-Uribe and Leatherbee (2017)	(1) Effect of basic accelerator services on new venture performance; (2) Effect of schooling and basic services	Quantitative	3,258 accelerator applicants and 276 pitch-day competitors	Study based on an individual accelerator program (Start-up Chile). Start-ups selected for access to entrepreneurship schooling tend to achieve more intermediate milestones
Yu (2019)	(1) External financing and venture growth; (2) Acquisitions; (3) Closures	Quantitative and qualitative	13 accelerators and 70 interviews	Start-ups admitted to accelerators are less likely to achieve key milestones

Source(s): Own compilation from the literature revision; Compiled by the authors from the literature review

Table 1.

Few studies have used quantitative analyses to measure the impact of a global set of SAs on the performance of their accelerated start-ups. Gonzalez-Uribe and Leatherbee (2017) used a sample of 3,258 applicants to an individual accelerator programme (Start-up Chile) and found that access to certain basic services, such as the coworking space provided by the programme, had a limited impact on the future performance of Start-up Chile graduates. Cohen *et al.* (2019) used a sample of 146 US accelerators and 100 interviews to confirm a connection between SAP design and the performance of the accelerated start-ups. Fehder and Hochberg (2019) examined a list of 59 accelerators founded between 2005 and 2013. They concluded that the arrival of an accelerator is associated with a significant increase in the volume of seed and early-stage deals, driven by outside investor groups and the emergence of new local early-stage investors. Hallen *et al.* (2019) used a matched sample from four cohorts of eight top US accelerator programmes to compare treated and untreated start-ups. They found evidence that accelerators substantially aid and accelerate venture development. “Novel learning” was observed to be the key driver of the accelerator effects. Finally, Yu (2019) compared start-ups affiliated with 13 accelerator programmes to (non-accelerated) start-ups backed by venture capitalists (VCs). The findings suggest that new ventures admitted to accelerators are less likely to reach key milestones. In contrast to these recent studies, our subject of analysis is the accelerator itself rather than the hosted companies.

2.3 The accelerator’s location

Analysis at the country level has attracted ample attention in the BI literature. Many BI studies have focused on developed countries (Chen, 2009), principally the United States (Mian, 1997; Rothaermel and Thursby, 2005) and European countries (CSES, 2002; Clarysee *et al.*, 2005). Many BI studies provide comparisons between BI activity in these two markets (Aerts *et al.*, 2007). Other studies have focused on particular countries such as the United Kingdom (Soetanto and Jack, 2013), Finland (Abetti, 2004), Sweden (Lindelof and Lofsten, 2002), Germany (Schwartz and Hornych, 2008, 2010; Schwartz, 2013), Italy (Colombo and Delmastro, 2002), Israel (Rothschild and Darr, 2005), Spain (Peña, 2004) and Portugal (Ratinho and Henriques, 2010). Others have examined developing countries (Akçomak, 2009) such as Brazil (Etzkowitz *et al.*, 2005), the Gulf Cooperation Council countries (Mubaraki and Busler, 2010) and Turkey (Özdemir and Sehitöglü, 2013). Whilst there is abundant coverage of BIs, broad studies based on worldwide surveys of incubators are practically non-existent.

Europe and the United States host a comparable number of start-up programmes per capita. In Europe, the number of SAs has increased dramatically since the start of the financial crisis in 2007. Between 2007 and 2013 the number rose by almost 400% (Salido *et al.*, 2014). SAs have emerged as a plausible way of creating job opportunities and technology-based businesses, revealing innovative ways to offer products that can conquer the international market and grow without the need for huge injections of capital (Christiansen, 2009; Cohen, 2013).

The accelerator phenomenon was born in the United States, and despite extensive globalisation, it is still the undisputed leader in terms of the number of acceleration programmes. Of the top 20 SAPs, 15 are located in the United States. Silicon Valley pioneers new forms of the original SA model. The United States also plays a leading role in the development of university-driven accelerators. Start-x (Stanford) and Skydeck (UC Berkeley) offer notable examples. The same is true of corporate accelerators, which are now flourishing around the world. The purpose of our first hypothesis is to test the extent to which the United States leads in SAs.

H1. Accelerators located in the United States tend to be larger and surpass their foreign counterparts in terms of key SA performance ratios.

2.4 Investment in SAs

A key indicator of the prospects and expectations of most high-tech companies, especially start-ups, is the presence of funding by external investors, primarily VCs. SAPs are expected to make their hosted start-ups more appealing to VCs and business angels. Similarly, firms that succeed in attracting external investors are expected to have more chances of survival and growth. These better chances are because there is generally a positive association between VC finance and growth, although this view is not unanimous (Bottazzi and Da Rin, 2002). As noted by Bertoni *et al.* (2011), most studies of VCs suffer from a bias because they consider only IPO firms. This approach leaves privately held firms unstudied, the vast majority of which are start-ups.

Accelerated start-ups have better chances of attracting VC investment and closing investment rounds if they adapt to the VCs' preferences for investing in firms whose founders have management, educational and professional experience (Bertoni *et al.*, 2011; Colombo and Grilli, 2010; Puri and Zarutskie, 2008). These are precisely the areas where most entrepreneurs improve during SAPs.

Firms with VC investment tend to excel over others in most performance indicators (Gompers and Lerner, 2001; Dennis, 2004). In the context of start-ups, closing successive investment rounds is vital and offers the route to a marketable solution and the gateway to customers. Prestigious VC funds provide extra marketplace credibility to participating firms and greater attractiveness to new investors. In addition, these start-ups seem to have easier access to valuable skills and resources (Colombo *et al.*, 2006; Hsu, 2006) and have more chance to grow in employment terms (Bertoni *et al.*, 2011). Davila *et al.* (2003) performed a broad study of 494 Silicon Valley start-ups, concluding that the quality, reputation and credibility of new ventures is enhanced when an investment round is undertaken by a VC.

In accordance with these findings and conclusions from the literature, we assume that receiving sufficient investment from a VC by closing an investment round above US\$ 1 million improves start-ups' expectations and growth prospects. Most entrepreneurs starting ventures in Silicon Valley share the view that closing at least an A round of investment (US\$1–5 million) and, ideally, a B round (over US\$5 million) is the main success indicator. For practically all such start-ups, this amount is viewed as sufficient to keep pace and fuel their growth. The arguments in this section lead us to formulate our second hypothesis.

H2. Accelerators with higher levels of average total rounds per company outperform others in the main performance ratios.

3. Empirical analysis

3.1 Analysis model

The previous literature review reveals that, despite the vast number of empirical studies assessing the impact of BIs, there is a lack of consensus on BI performance measurement. In addition, the absence of a single standard method makes any analysis of BI efficiency and performance even more difficult (Phan *et al.*, 2005; Bergek and Norrman, 2008; Schwartz and Gothner, 2009; Ratinho and Henriques, 2010). Further, few studies have used a robust quantitative approach to assess the economic effects of incubator organisations. In addition, most results and findings are inconclusive and somewhat contradictory. Table 2 summarises some of the most significant variables that have previously been used in the BI literature.

Given the lack of specific variables for measuring SAPs and in light of the BI literature review in the previous section, we propose a model for measuring SA performance, with variables grouped into three categories.

- (1) Size. Variables in this category provide quantitative information regarding the actual size of the accelerators: (1) Total funding: total amount of capital invested in the participating companies; (2) Total employees: total number of employees in the participating companies; (3) Total rounds: total number of investment rounds; (4) Total companies: total number of accelerated companies in each accelerator.
- (2) Location and age. This category comprises two typical control variables: (1) Country: location of the accelerator (United States or elsewhere); (2) Founding year: period in which the accelerator started to operate (1995–2000, 2001–2005, 2006–2010 or 2011–2014).
- (3) Performance ratios. Indicators and ratios suggested by Crunchbase (2018): (1) Total exits: amount of capital obtained by the accelerator through the exit of participating companies. This variable is only available for accelerators that have exited companies; (2) Average total exits per company (total exits/total companies); (3) ROI (return on investment) factor (total exits/total funding) \times 100, which reflects the return on investment by the accelerator through company exits; (4) Average total funding per company (total funding/total companies); (5) Average total investment rounds per company (total rounds/total companies); (6) Average employees per company (total employees/total companies).

3.2 Data

One of the main limitations to increasing knowledge about SAs lies in the absence of large-scale representative databases that include data on programme features and the companies that enter and graduate from the programmes (Cohen and Hochberg, 2014). In accordance with the accelerator definition used in this study and to ensure a certain degree of homogeneity, we limited the type of SAs to those that meet the following selection criteria:

Average capital investment cost

Number of incubator tenants
Funding received
New firms created
Exit policy
Development of the local economy
Employment generated
Profitability

Table 2.
Variables to measure
performance used in
previous BI studies

(1) located in the United States and elsewhere, (2) at least four years old, (3) take equity in exchange for investment, and (4) are not mostly funded by private investors. An initial set of 191 SAs worldwide met these selection criteria. Of these, 100 were included in Seed-DB [1] an online accelerator database that probably represents the largest public repository of accelerators and graduate data (Hochberg, 2016).

The other 91 were hand-collected from crunchbase, which is an open source database with partnerships with more than 400 venture capital firms, accelerators, incubators and angel groups to ensure the accuracy of the data (Yu, 2019). Crunchbase tends to have more early-stage transactions than similar databases, which makes it ideal for hand-collecting data on the companies in our sample. Then, we used AngelList and LinkedIn profiles for verification purposes.

The presence of missing data for some variables forced us to delete some SAs initially exported from the Seed-DB database. The final sample consisted of 116 SAs, of which 72 were located in the United States and the remaining 44 in other countries.

4. Results

4.1 Descriptive analysis

Total funding ranged from a minimum of US\$ 9,000 to a maximum of US\$ 2.2 billion. In addition, 62.93% of accelerators invested more than US\$ 1 million in their accelerated companies.

SAs have not yet excelled as employment seedbeds. Only one had generated more than 1,000 jobs in participating companies, and over 80% of SAs had not yet created 100 new jobs. Only 25 accelerators participated in 10 or more rounds. In terms of the number of participating companies, 46 accelerators hosted 20 or more start-ups and 10 hosted more than 50. The largest accelerator supported 585 new ventures.

As expected, younger SAs hosted fewer companies, created fewer jobs, generated less total investment and completed fewer total rounds. When the accelerator had been operating for four years, the differences in terms of size indicators tended to grow exponentially, as shown in Table 3.

The location and age of the accelerators are of interest. The accelerators were grouped into four age intervals based on their founding year: 1995–2000, 2001–2005, 2006–2010 or 2011–2014. Our data confirm the young status of the SA phenomenon, with 91.38% of SAs founded from 2006 onwards (Table 4).

In terms of performance and effectiveness indicators, the most significant profitability ratio (ROI) was only available for 19 SAs.

4.2 Results of bivariate and multivariate analyses

Bivariate and multivariate analyses were used to test the two hypotheses. The bivariate analysis provided statistically significant results regarding the differences between two groups based on a single variable.

Min-max rates per period and total SA survey	1999–2005	2001–2005	2006–2010	2011–2014
Total funding (US\$)	80,397,018	11,697,500	15,000	9,000
Total exits value (US\$)	2,202,878,093	164,000,676	103,305,094	8,455,000
Total employees in participating companies	17,000,000	500,000	0	0
Rounds of investment	1,276,008,100	390,750,000	22,500,000	25,000,000
N° participating companies	326–3667	121–763	11–270	3–34
	56–492	8–142	0–98	0–5
	110–585	63–77	11–49	3–10

Table 3.
Descriptive analysis of rates per period

Source(s): Own compilation

The existence or absence of significant differences between groups of SAs in terms of the variables in the model was verified using the non-parametric Kruskal–Wallis* or Mann–Whitney U** test. The required level of significance in the comparisons was 95%.

For testing Hypothesis 1, a bivariate analysis was conducted using *country of location* of the SAs as the grouping variable. US accelerators (72 in total) were thus distinguished from non-US accelerators (44 in total). Table 5 summarises the results of this bivariate analysis. We observed statistically significant differences based on country of origin for the following variables: *total rounds* (category 1), *average total funding per company* (category 3), *average employees per company* (category 3) and *average total rounds per company* (category 3). All four variables had higher values for the SAs located in the United States. Three of the variables corresponded to category 3 (performance ratios), which indicates that levels of profitability and efficiency are higher in US accelerators.

Next, to test Hypothesis 1 with greater precision, we ran a binomial model with *country* as the dependent variable. This variable took a value of 1 if the accelerator was located in the United States and 0 if the accelerator was located elsewhere. The intrinsic features and nature of the data made binomial logistic regression models suitable.

From the initial set of six variables, those used in the regression model were selected using the stepwise regression method. After each variable was added, all candidate variables in the model were checked to observe whether their significance had been reduced below the specified tolerance level. The Akaike information criterion (AIC) was employed to compare the different models. The model with the lowest AIC comprised only two independent variables:

$$\text{Country} = A(\beta_1 + \beta_2\text{Foundation} + \beta_3\text{Average Total Funding}) + \mu_i$$

The results are displayed in Table 6, with the estimated coefficient and the standard error. In this model, the only significant variable was *average total funding per company*. The model fit was satisfactory, with an AIC value of 136.12.

Accelerators' evolution	Total SA Global survey	US (%)	Other countries (%)
1995–2000	3	1.72%	0.86%
2001–2005	7	5.17%	0.86%
2006–2010	63	32.76%	21.55%
2011–2014	43	22.41%	14.65%
Total	116		

Source(s): Own compilation

Table 4.
Descriptive analysis of
Accelerators evolution

Variable	Differences on average	T student	p-value
Total companies	–14.183	–1.299	0.115
Total exits	–23986086	–1.299	0.197
Total funding	–46780226	–1.526	0.131
Total employees	–89.752	–1.706	0.092
Total rounds	–17.626	–2.368	0.020
% ROI factor	56.433	0.746	0.459
Average total funding per company	–495598	–4.942	0.000
Average total exits per company	–64603.18	–0.606	0.545
Average employees per company	–0.843	–3.201	0.001
Average total rounds per company	–0.294	–4.496	0.000

Source(s): Own compilation

Table 5.
Differences analysis
based on country of
origin: US vs Non-US:
Survey 1 (N = 116)

Table 6.
Logistic regression
results

Independent variables	Estimated coef.	Standard error	<i>p</i> -value
Constant	0.045	0.308	0.884
Year of Foundation(1)	–	–	–
Total Funding +1M,-1M	–0.902	0.538	0.094
% Multiplier factor	–	–	–
Average Total Funding	$3.15 \cdot 10^{-6}$	0.000	0.002
Average Total Exits	–	–	–
Average employees	–	–	–
Average Total Rounds	–	–	–
<i>AIC</i>	136.12		

Source(s): Own compilation

Average total funding was the only variable identified by both the bivariate and multivariate analyses. It is therefore considered the key component characterising SAs located in the United States.

To test Hypothesis 2, we applied a Tweedie distribution for generalised linear models (GLMs; tweedie), with the logarithm of the average total rounds per company as the dependent variable. To check the normality of the continuous variables, a Shapiro–Wilk test was run. All the *p*-values were greater than the significance level of 0.05, which implied that the variables did not follow a normal distribution.

When running GLMs, several models are typically feasible and valid. Three GLMs models were run with the *average total rounds per company* as the dependent variable and with the following independent variables:

- (1) Model 1: founding year, country, average total funding, average employees and total funding
- (2) Model 2: total companies, total exits, total funding, total employees and country
- (3) Model 3: total companies, % multiplier factor, average total funding, average total exits, average employees and country.

After running all the models, the best model – and the one that was selected – was based on Model 1. It comprised three significant independent variables: *average funding*, *average employees* and *total funding*. Consequently, one key finding is that the SAs that close most rounds of investment per company are those that have a higher amount of funding per company, a higher average number of employees per company and a larger amount of funding being raised from investors.

Accordingly, as stated in Table 7, these are the three key factors that SAs should prioritise to outperform others in terms of ability to close more investment rounds for start-ups participating in their programmes.

Independent variables	Estimated coef	standard error	<i>p</i> -value
Constant	–4.279	0.437	0.000
Average funding	$4.5 \cdot 10^{-7}$	0.000	0.020
Average employees	0.227	0.075	0.003
Total funding	2.230	0.478	0.000
<i>AIC</i>	102.193		

Source(s): Own compilation

Table 7.
GLM model: Results

5. Discussion

A summary of our findings, connected to our two hypotheses, is presented below.

- (1) US accelerators: SAs located in the United States tend to attract more funding for their tenant start-ups. This capacity to raise more funding is the primary advantage of US accelerators over those located elsewhere.
- (2) Investment: Our findings suggest that SAs with a greater ability to close funding rounds are more likely to generate more accelerated companies, employment and local economic development.
- (3) Accelerator networks: Entrepreneurs are more attracted to SAs that offer greater networking opportunities. Therefore, being located in an established entrepreneurial ecosystem enhances an accelerator's chances of attracting capital and consequently first-class, talented entrepreneurs.
- (4) Local influence: The more successful the SA is, the higher its business influence and reputation in the area will be, helping new companies attract attention from local agents.

The last research question addressed by this study refers to the performance record of a group of representative SAs in a set of key performance indicators. Table 8 displays data for the top SAs based on a series of performance indicators, including those identified by our study. As of June 2018, the Seed-DB crunchbase database covered 190 SAPs worldwide, with 7,450 accelerated companies, 1,024 exits worth US\$ 7 billion and US\$ 40 billion of total funding raised. Table 8 displays the evolution of the top 13 SAs from June 2014 to June 2018. The data show a dramatic growth in almost all indicators, with the figures for some SAs increasing by a scale of 1–10 or even more. Total funding increased by a factor of more than 10 over these four years, whilst average funding in 2018 grew to US\$ 5 to 7 million from less than US\$ 1 million in 2014. The growth achieved in terms of number of exits, which is a key success indicator for start-ups and SAs, was also remarkable.

Accelerator	Country	Found year	Total funding 2014	Total funding 2018	Average funding 2014	Average funding 2018	N. exits 2014	N. exits 2018
Y Combinator	US	2005	2200	23000	3.7	15	57	188
Techstars	US	2006	500	5100	2	5	29	129
500 Startups	US	2010	97	1800	0.46	2.6	10	158
AngelPad	US	2010	148	1000	2	7.4	10	22
DreamIT Ventures	US	2007	97	750	1.1	3.8	3	17
SeedCamp	UK	2007	80	620	0.73	5.3	6	26
Amplify.LA	US	2011	9.5	350	0.41	9.7	1	11
RockHealth	US	2010	37.5	340	0.77	7	1	13
Imagine K12	US	2011	33	300	0.92	4	0	5
UpWest Labs	US	2012	4.5	290	0.27	6.9	0	10
Launchpad LA	US	2009	39.2	230	1.5	7	0	6
Portland Incubator	US	2009	52.4	150	2.4	5.1	0	5
StartMate	AUS	2010	6.9	100	0.33	2.2	1	2

Source(s): Crunchbase, 2018

Table 8.
Top SAs in the world

6. Conclusions and implications

As the SA phenomenon is still so new, there remains widespread uncertainty about SAs' prospects and the conditions required for SAs to succeed (Pauwells *et al.*, 2016). This study breaks new ground in the SA field by exploring the efficiency and overall performance of a wide array of initiatives labelled as SAs.

This paper offers a new proposal for the quantitative performance assessment of SAs using three categories of variables: size, location and age and performance ratios. Our findings provide valuable insight into the accelerator process for new ventures. A profile of SAs can be identified from the results of our empirical study:

- (1) Accelerators located in the United States only outperform those located elsewhere in their capacity to attract funding for participating start-ups.
- (2) SAs with greater chances of closing investment rounds for their tenant start-ups are those that receive larger amounts of total funding and that host new ventures with more employees per company. Investors seem to prefer start-ups in a more advanced stage of development.

This profile has a range of practical implications for SA managers, entrepreneurs and investors. SA stakeholders now have access to more accurate information about key expectations linked to the size, age and location of SAs. Entrepreneurs are better informed in the process of choosing the best accelerator to host their business projects. Performance indicators are especially helpful for investors, who are primarily concerned with the percentage ROI factor, the period and the investment rounds needed to achieve an exit.

Another key issue is the SA's role as an employment seedbed. The impact of SAs on the generation of employment is difficult to measure because it usually occurs in the tenant companies' later stages of development (the so-called scale-up process). Nonetheless, the number of new companies born today is remarkable, and in terms of employment, the results are promising.

Our findings also offer important implications for entrepreneurs, venture investors and policymakers. Entrepreneurs can gain insight into how to take full advantage of participating in an SAP.

A review at the end of 2018 of the top 20 SAs in terms of total funding (Crunchbase, 2018) reveals that the percentage of hosted start-ups with over 100 employees ranged from 3% to 6%. The comparative data shown in Table 8 reveal a remarkable increase in two key performance indicators: average funding and number of exits per accelerator. This jump in both indicators confirms the growing credibility and popularity of SAPs amongst investors and start-up founders, regardless of their location. The significant proportion of tenant start-ups having received funding of more than US\$ 1 million is also noteworthy. However, performance in terms of number of exits of more than US\$ 1 million is not so positive. In the top 20 SAs in terms of funding, this milestone was reached by only eight SAs in 2018. This finding confirms that a substantial exit, the ultimate goal of most start-up founders, requires longer periods in business than the few months offered by SAPs.

In connection with most previous studies, our findings suggest that SAs play a substantial and supportive role to enhance the prospects and expectations of most tenant companies. However, the literature does not yet definitively show a higher survival rate amongst firms hosted in SAs.

This study is not free from limitations. First, the data on many of the SAs in our sample came from Seed-DB, a global online SA data set mostly biased towards US accelerators. Consequently, SAs located elsewhere are largely underrepresented. In addition, this public database of accelerators has a number of disclaimers, including incomplete data and missing programmes, companies and values. Missing data and zero values forced us to reduce the initial sample of 191 SAs to just 116. Further, many newly created SAPs were not considered.

Second, some performance indicators suffer from data scarcity, especially the two key profitability ratios: *ROI factor* and *total number of exits completed*. Neither of these start yielding results until the participating companies have traded for at least five years. Almost all of the companies supported by the youngest accelerators are at too early a stage to exit the programme.

Third, the meaning and implications of *total funding* might be misleading because this variable only captures the money invested in start-ups, ignoring the contributions made by mentors and the infrastructure and overhead support of the SAs.

Fourth, SAs take equity in start-ups in exchange for support and funding. They expect to harvest profits through exits, measured using the % ROI factor. However, if a start-up is not sold or new investors fail to buy out the percentage that the SA is willing to release, this does not mean that the company is not creating some return on investment for the SA through either profit sharing or, for example, dividend distribution. Data on these additional profitability indicators would enable a more accurate evaluation of the returns to the companies and the SAs.

Finally, a methodological limitation that is difficult to overcome lies in how to gauge the actual role played by the accelerators in the success of participating firms. Their role in the early stages seems crucial, but the question of whether these start-ups would have been equally successful without SA intervention remains unanswered.

Accelerators are likely to continue to evolve and their impact may change further. Thus, additional research is needed to examine the consistency of our findings in newer accelerators. Undoubtedly, further research is needed to address the following questions, amongst many others: What proportion of start-ups might have prospered without the aid of an accelerator, and what can we learn from the effect of dilution?

Note

1. The Seed Database. This database (available at <http://www.seed-db.com/>) is updated and synchronised daily using data from Crunchbase (2018) and AngelList (2018). Updates are completed by SA managers registered on this website. At the time of our last consultation (November 18, 2018), the number of registered accelerators was 147. Although these data are global, they largely relate to U.S. SAs.

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Bank performance variability and strands of inflationary conditions

The US
banking sector

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Received 28 September 2018
 Revised 21 June 2019
 21 November 2019
 29 January 2020
 Accepted 3 August 2020

Abstract

Purpose – This study seeks to examine the extent to which strands of inflationary related conditions (inflation expectations, inflation uncertainty and realized inflation); macroeconomic uncertainty and the likelihood of recessionary conditions influence performance indicators in the US banking sector over a specified time period.

Design/methodology/approach – The study adopts seemingly unrelated regression model (SUR) advanced by Zellner (1962) in its examination of how specific strands of inflationary conditions, and other adverse macroeconomic conditions influence performance dynamics in the US banking sector.

Findings – Empirical evidence suggest that among various adverse macroeconomic conditions examined, inflation expectations and macroeconomic uncertainty tend to have significant constraining impact on key performance indicators in the US banking sector than other conditions examined. Comparatively, this study finds that inflation expectations and macroeconomic uncertainty tend to have much more constraining impact on return on equity, than on return on assets in the US banking sector. Results further suggest that among the three bank performance indicators examined, net interest margin is the least vulnerable bank performance indicator to various adverse macroeconomic conditions examined in the study.

Practical implications – Apart from the various empirical results noted above, this study's findings are projected to help inform strategic planning decisions among institutions in the banking sector. The various findings could, for instance, inform policies and operational strategies geared toward reducing vulnerability associated with specific performance indicators such as return on equity. This reduction could be achieved by critically examining how the various performance indicators react to individual adverse macroeconomic conditions examined in this study. The process could ultimately help in developing tailored measures/procedures aimed at reducing how susceptible key performance indicators are to the various adverse macroeconomic conditions. This study's findings could also provide the platform for more adaptive policies aimed at minimizing the effects of noted macroeconomic conditions on operational efficiency in the banking sector.

Originality/value – The uniqueness of this study, compared to related ones found in the literature, stems from its treatment of three related strands of macroeconomic condition (different variant of inflationary conditions) in the same framework in its empirical analysis.

Keywords Adverse macroeconomic conditions, Bank performance, Seemingly unrelated regression

Paper type Research paper

1. Introduction

The fundamental view that macroeconomic conditions influence bank operational activities and performance dynamics is not new to the finance and economics literature. Significant number of empirical studies focusing on this interaction (how macroeconomic conditions influence activities of financial institutions), such as Mougillansky (2002); Demir (2009), etc.

JEL Classification — E32, E44, F62, G21

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European Journal of Management
and Business Economics
Vol. 29 No. 3, 2020
pp. 235-253
Emerald Publishing Limited
e-ISSN: 2444-8494
p-ISSN: 2444-8451
DOI 10.1108/EJMBE-09-2018-0100

have reported divergent conclusions on how various macroeconomic conditions influence specific performance indicators among financial institutions such as banks. Despite extensive existing literature on this ever-evolving link, the relationship continues to engender significant interest due to transient and often unpredictable nature of most macroeconomic conditions. This growing interest (focus on how macroeconomic conditions influence bank performance) has been attributed to two core factors according to reviewed literature. The first is the continuous need to be abreast with evolving effects of such macroeconomic conditions on bank profitability for strategic planning in a highly competitive business environment. The second rationale revolves around the need to periodically evaluate potential inimical impact such macroeconomic conditions may have on operational activities in order to reduce operational vulnerability to such conditions. For most firms and financial institutions such as banks, this second objective is often achieved through measures specifically designed to make operational activities more resilient to various macroeconomic conditions. Unlike most of the related literature focusing on the dynamic relationship between macroeconomic conditions and performance in the banking sector, this study is designed to have relatively narrow focus in its empirical assessment. Specifically, we seek to examine the extent to which strands of inflationary related conditions (inflation expectations, inflationary uncertainties and realized inflation), macroeconomic uncertainty and the likelihood of recessionary conditions impacts selected performance indicators in the US banking sector. In other words, apart from effects of macroeconomic uncertainty on banking sector performance, which one could readily find examples in the literature, we also examine the extent to which the likelihood of recessionary conditions and combined effects of strands of inflationary related conditions influence variability in specific banking sector performance indicators in the US economy.

1.1 The case for the study

Reviewed empirical studies (examples presented in literature review) suggest that operational efficiency and performance among financial institutions such as banks are shaped by both industry-specific and external macroeconomic factors. This study subscribes to this view because significant empirical studies exist in the literature in support of such position. However, conclusions in the present literature notwithstanding, we present an alternative view. We hypothesize that although industry-specific factors such as bank size, ownership structure, etc. (Akhavain *et al.* (1997); Smirlock (1985); Athanasoglou *et al.* (2008); Heffernan and Fu (2008)) are integral in bank performance assessments, prevailing/anticipated macroeconomic conditions may explain relatively more of the fluctuations in such performance. In other words, although industry-specific factors play a crucial role in determining performance among financial institutions such as banks, we are of the view that exogenous nature of macroeconomic conditions (the fact that firms have relatively less control) may make such conditions more central to performance dynamics all things being equal. This position stems from the assumption that ordinarily financial institutions such as banks have some measure of operational control in dealing with industry-specific factors; however, the same cannot be said of a much broader macroeconomic condition such as recession. Again, although we agree with various empirical conclusions about the importance of industry-specific factors in bank performance, we surmise that broader prevailing or anticipated macroeconomic conditions might have more influence on such performance. In other words, as crucial as industry-specific factors are, bank performance dynamics may depend more on how resilient such institutions are to a more pervasive external macroeconomic shocks all things being equal. In addition, unlike industry-specific factors, which often affords banks some reasonable preemptive choices, random and unpredictable nature of most adverse macroeconomic conditions often puts banks in a reactionary mode despite best forward-looking strategies.

The uniqueness of this empirical review revolves around its examination of three variant of inflationary conditions in the same empirical framework. Ongoing debate on the relationship among these three strands of inflationary conditions suggests that the conditions might have divergent effect on key performance indicators all things being equal. For instance, there is a growing view that inflationary uncertainty might be more inimical to institutional performance than inflation expectations since the former tend to make such entities more vulnerable due to vague signals to inform strategic planning. Reviewed literature further suggests that this inquiry might be the first to examine the combine effects of such related strands of macroeconomic conditions (inflation expectations, inflation uncertainty and inflation) in a framework focusing on performance in the banking sector. Apart from the core objective of the study, the approach adopted will also allow us to identify the underlying interactions among various macroeconomic variables, and how they ultimately affect performance indicators in the US banking sector.

The following questions largely defines the scope and structure of various analysis pursued in this empirical study. (1) Are the various adverse macroeconomic conditions significant in explaining fluctuations in key bank performance indicators? (2) Are there empirically significant variations in how strands of related adverse macroeconomic conditions affect bank performance indicators? Finally, (3) a determination of macroeconomic condition influencing much of the variability in reviewed banking sector performance indicators. The rest of the study is structured as follows; the next section reviews historical trend in the US banking sector performance, focusing on the three performance indicators. This is followed by a critical examination of strands of inflationary-linked conditions. Section three reviews relevant literature on structure of the US banking sector, examination of relationships between bank performance and various macroeconomic conditions in the study, and an overview of the bank profitability literature in general. Sources of data and empirical methodology adopted are presented in subsequent sections. Empirical tests and analysis of the results are presented in the final sections. The study concludes with a review of major findings and potential policy implications.

2. Historical trends in the US banking sector performance

This section critically examines key bank performance indicators over the period captured in the study. The goal is to illustrate graphically the historical performance trend associated with each performance indicator over the study period and verify if such trends reflect any notable macroeconomic conditions over the same period. Banking sector performance indicators examined are divided into two categories; profitability indicators measured by return on assets (ROA) and return on equity (ROE) and a proxy for operational efficiency using net interest margin (NIM).

2.1 Return on asset (ROA)

Figure 1 below illustrate historical performance features associated with ROA among the US banks over the period captured in the study. A critical examination of Figure 1 suggests that over the study period, there were two major significant periods of decline in return on assets in the US banking sector. The first of such decline was recorded in the second quarter of 1987, when ROA in the US banking sector recorded a percentage change of -0.37% . After this period, the trend improved significantly, but continued to fluctuate with a positive trend until the fourth quarter of 2006, when ROA experience another sharp decline from a peak of 1.35% . This second declining trend persisted until the fourth quarter of 2009 with a recorded lowest decline of -0.10% before the trend experienced another upward trend. A key noticeable feature associated with ROA trend over the period under consideration is its responsiveness

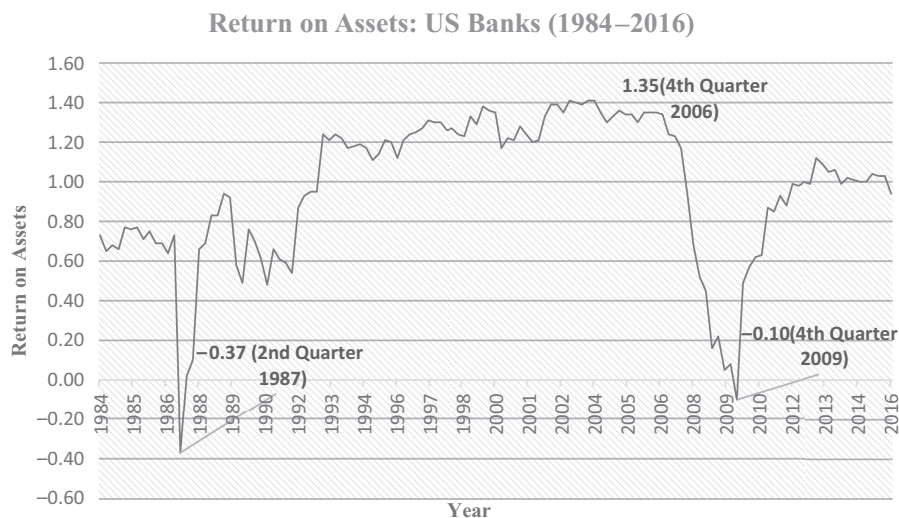


Figure 1.
Trends in return on
assets

to a notable macroeconomic condition over the same period. Critical examination of conditions during this period suggests that the decline in trend coincided with recent recessionary condition brought about by the US mortgage crisis. This simultaneous movement in decline in ROA and the recent recession in the US economic history to some degree suggest that macroeconomic condition such as recessionary environment tend to have significant negative influence on banking sector performance (ROA), all things being equal. This phenomenon to some extent lends support to the projection that adverse macroeconomic could account for significant fluctuations in performance in the banking sector.

2.2 Return on equity (ROE)

Historical performance characteristics associated with return on equity, the second banking sector performance indicator examined, to some degree mimic similar trajectory exhibited by ROA in terms of how the performance indicator fluctuates given similar macroeconomic conditions. However, in this instance, observed percentage change in how the performance indicator fluctuates over time is comparatively higher. Figure 2 suggests that ROE trend in the US banking sector also declined significantly during the recent recessionary period; a condition, which further supports the preposition that undesirable macroeconomic conditions could, all things being equal, have a significant constraining impact on banking sector performance.

2.3 Banking sector efficiency: net interest margin

Compared to the first two bank performance indicators discussed, net interest margin is employed as a proxy for efficiency in the US banking sector. The use of net interest margin (NIM), as a proxy for bank operational efficiency or bank efficiency, follows existing empirical precedents and suggestions from related studies. Demircug-Kunt and Huizinga (1999); Vensel *et al.* (2004); Sidabalok *et al.* (2011); Marinković and Radović (2014) and Angori *et al.* (2019) have either employed NIM as a measure of bank efficiency or alluded to it as being a good proxy for bank efficiency. Figure 3 below suggests that this performance indicator is characterized by historical trend conditions that are significantly distinct from those

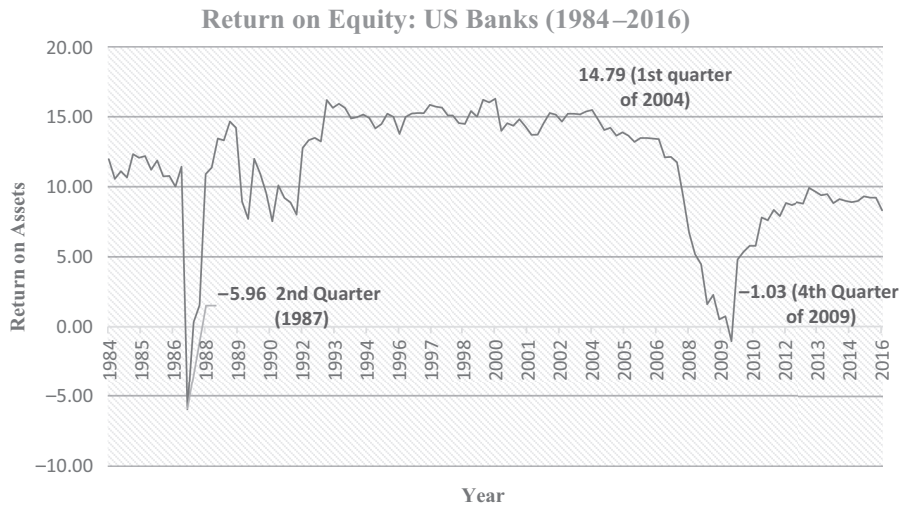


Figure 2. Trends in return on equity

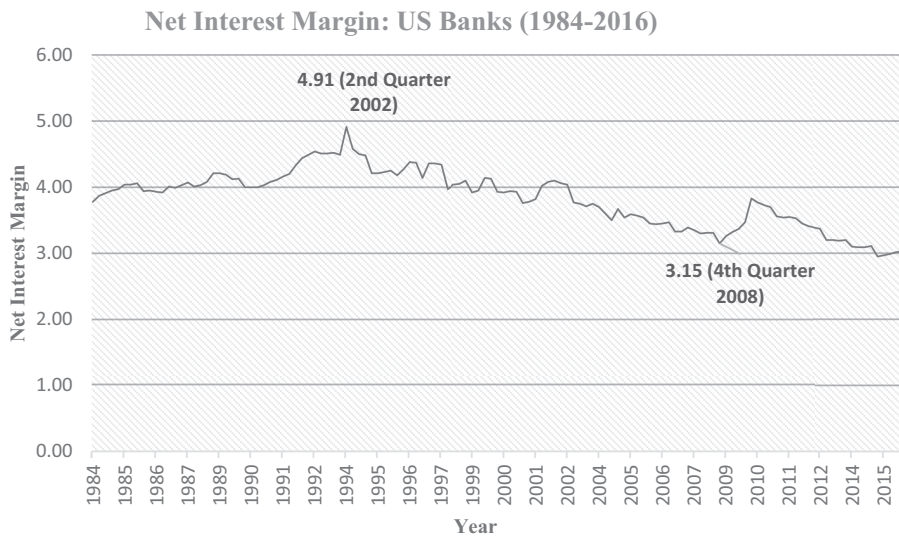


Figure 3. Trends in net interest margin

experienced by return on assets and return on equity over the same period. For instance, between 1984 and 2002, while both return on assets and return on equity were characterized by extreme volatility, NIM according to Figure 3, rather experienced appreciable growth over the period. In addition, NIM seemed not have been significantly by the recent recessionary condition which devastated other profitability indicators discussed above over the same period. Figure 3 suggests that NIM over the period averaged over 3% with relatively minimal volatility compared to the first two performance indicators. These divergent trend features exhibited by the three performance indicators to some degree suggest that significant differences may exist in how these key performance indicators respond to various macroeconomic conditions; a feature we seek to verify empirically in subsequent sections.

3. Inflation, inflation uncertainty and inflation expectations

This section examines strands of related macroeconomic conditions employed in subsequent empirical analysis. The first of these conditions is inflation; this macroeconomic condition defines percentage change in a specific price index. Theoretically, inflationary condition affects the value of financial assets and other financial instruments in a bank's portfolio and ultimately the return accruing on such assets over time. Inflationary condition, for instance, could affect the value of investment returns and for that matter overall profitability or performance all things being equal. In addition, inflationary conditions have also been shown to influence variability in the value of bank assets holdings and operational efficiency. Given this theoretical link on how bank's assets value could be impacted by inflationary pressures, we project that inflation could negatively influence assets base of banks and ultimately, overall performance.

Compared to inflation, inflation uncertainty, the second related macroeconomic variable examined, rather captures perceived ambiguity about potential inflationary conditions instead of the actual condition as defined above. We project that this macroeconomic condition (inflation uncertainty) could affect investment performance in the US banking sector because the condition can affect potential for realizing expected returns or performance projections. The last of the inflation-related conditions, inflation expectations, capture a scenario where banks or financial institutions anticipate inflationary conditions due to ongoing or impending policy decisions or macroeconomic conditions. The extent to which inflation expectations may influence performance indicators in the US banking sector revolves around the assumption of rational behavior on the part of banks as economic agents. We postulate that if banks subscribe to assumption of rational expectations theory where all available information including relevant expectations inform present decisions and operational strategy; then inflation expectations may have significant impact on bank operational activities and ultimately key performance indicators all things being equal. It is important, however, to point out a marked difference between inflation uncertainty and inflation expectations variables. The key difference between the two macroeconomic conditions revolves around how signals on changes in future price levels (inflation) are interpreted by economic agents or entities such as banks. A much clearer signal attesting to an impending significant change in a price index or increases in general price levels constitutes inflation expectations; however, a distorted or vague signal about potential inflationary condition leads to inflation uncertainty. We project that these variants of inflationary conditions could have divergent impact if any on selected bank performance indicators. Table 1 summarizes projected effects of the various macroeconomic variables namely, macroeconomic uncertainty, inflation uncertainty, recession probability, inflation expectations and inflation on ROA, ROE and NIM.

4. Literature review

4.1 *The US banking sector*

According to the Federal Reserve Bank of St. Louis, the US banking system currently consists of more than 4,605 commercial banks and other authorized deposit-taking institutions. These commercial banks have the Federal Reserve System as the country's central bank. There are 12 Federal Reserve Banks at the apex of the US banking system, each task with the coordination of activities in different regions of the US economy. The Federal Reserve is responsible for monetary policies, maintaining stability of the financial system, etc. with the ultimate goal of price stability and sustaining confidence in the US financial and banking system. Apart from the Federal Reserve at the apex, the US banking system also features the Federal Deposit Insurance Corporation (FDIC), which was established in 1933 in responds to several bank failures prior to that year. The FDIC was set up to "*preserves and promote public*

Macroeconomic variable	Bank performance indicator	Projected effects
<i>Return on assets</i>		
Macroeconomic uncertainty		Negative
Inflation uncertainty		Negative
Recessionary probability		Negative
Inflation expectations		Negative
Inflation		Negative
<i>Return on equity</i>		
Macroeconomic uncertainty		Negative
Inflation uncertainty		Negative
Recessionary probability		Negative
Inflation expectations		Negative
Inflation		Negative
<i>NIM (proxy for Bank Efficiency)</i>		
Macroeconomic uncertainty		Positive
Inflation uncertainty		Positive
Recessionary probability		Positive
Inflation expectations		Positive
Inflation		Positive

Table 1.
Summary of projected
effects of various
macroeconomic
variables on bank
performance indicators

confidence in the US financial system by insuring deposits in banks and thrift institutions for at least \$250,000; by identifying, monitoring and addressing risks to the deposit insurance funds; and by limiting the effect on the economy and the financial system when a bank or thrift institution fails". In responds to ever-present threats to the finance and banking sector, the US government has since the 1980s implemented a number of banking sector reforms that are geared toward safeguarding and improving the banking sector to ensure sustained consumer and investor confidence. These reforms notwithstanding, the US banking sector continue to grapple with occasional challenges. These challenges include persistent low interest rates, increasing nonperforming asset among financial institutions, relatively weak economic growth and fiscal and trade policy uncertainties. The US banking sector also continues to contend with the threat of financial market contagion effects from other dominant financial markets due to growing integration of global financial markets. The most significant incident that characterized the US banking sector in recent years was the 2007 financial crisis brought about by the failure of the mortgage sub-market of the US economy. This crisis exposed some of the risky and illegal investment practices pursued by some banks and financial institutions. Some banks and financial institutions failed or were acquired in the process because of the financial crisis; notable among these were Wachovia Bank, Lehman Brothers, Bear Stearns, etc. The failure of these banks and financial institutions generated renewed call for proper monitoring of the activities of the US financial and banking system and the need for new and more stringent code of conduct on operational activities in the banking sector. This call culminated in the introduction of the Dodd-Frank Wall Street Reform and Consumer Protection Act (Public Law 111–203) enacted by the US Congress in 2010. The act was signed into federal law on July 21, 2010. This act brought about the most significant changes to financial regulation in the US banking sector since the regulatory reform after the Great Depression.

4.2 Inflation, inflation uncertainty, inflation expectations and bank performance

Relationships between some of the explanatory variables examined and bank performance have been reviewed in different formats in the existing literature. A critical overview of

related literature suggests that among the various explanatory variables examined in this context; inflation has received the most extensive empirical examination compared to the others in terms of how the condition impact profitability and performance in general. Our review suggests that comprehensive empirical examination focusing on the link between inflation uncertainty and key bank performance indicators are rare. In fact, we fail to identify any study specifically examining the relationship we seek to examine. In addition, a thorough review also suggests that the literature is limited in terms of how inflation expectations influence specific bank performance indicators. This empirical inquiry hopes to fill this gap in its examination of how aforementioned macroeconomic conditions influence key bank performance indicators in the US banking sector.

Among studies focusing on how inflationary conditions affect key bank performance indicators, Saeed (2014) found evidence suggesting that inflation has negative impact on key bank performance indicators such as ROA and ROE. In addition, in an earlier study, Bourke (1989) also found evidence alluding to negative relationship between inflation and bank profitability. Sufian and Chong (2008), Ayaydin and Karakaya (2014), Francis (2013) further provide evidence suggesting significant negative relationship between measured inflation (CPI) and bank profitability under varied conditions. Again, in a related study focusing on the relationship in question, Bordeleau and Graham (2010) further surmised that because operational activities of banks require that they lend money for longer periods than they borrowed, inflation as a macroeconomic condition tends to have negative impact by decreasing margins and profits.

Apart from the above studies alluding to negative relationship between inflation and key bank performance indicators, review of the literature suggest that significant empirical work exists suggesting a positive association between inflation and some bank performance indicators. Khan *et al.* (2014), for instance, found significant association between inflation and bank performance indicators such as ROA, ROE and NIM. Guru *et al.* (2002) also showed that inflation, as a macroeconomic condition tend to have positive impact on bank profitability and performance. In a study by Tan and Floros (2012) in which the role of inflation in bank performance was examined, the outcome further pointed to a positive association between inflation, bank profitability, cost efficiency, etc. in the Chinese economy. Pasiouras and Kosmidou (2007), in an earlier study also found evidence of positive association between inflation and profitability among a nation's domestically-owned banks. A positive association between inflation and bank performance or profitability was also found in the following studies: Athanoglou *et al.* (2008); Flamini *et al.* (2009) and Garcia-Herrero *et al.* (2009), respectively. This succinct review of related studies to some extent point to divergent effects inflationary conditions tend to have on bank performance indicators and operational activities.

4.3 Macroeconomic uncertainty, recession probability and bank performance

Apart from the role inflationary linked conditions play in bank performance reviewed above, augmented roles of macroeconomic uncertainty and recession expectations on banking sector performance are also examined. Reviewed literature on this relationship suggests that macroeconomic uncertainty all things being equal, tend to constrain or have negative impact on bank performance. For instance, in a study focusing on this association, Nier and Zicchino (2005) concluded that in economic downturns (macroeconomic uncertainty) banks tend to experience significant losses. In addition, Baum *et al.* (2005) further showed that macroeconomic uncertainty tends to distort efficient allocation of funds to potential borrowers. In order words, macroeconomic uncertainty was found to be inimical to operational efficiency in terms of loan management; a condition, which might influence bank performance since it affects the ability to make strategic decisions pertaining to risk

characteristics of borrowers and investments. This conclusion by Baum *et al.* is consistent with fundamental economic argument suggesting that macroeconomic uncertainty distorts forecast signals and frustrates strategic planning making it difficult to operate at the optimal level of performance. Talavera *et al.* (2006), who investigated effects of macroeconomic uncertainty on bank lending behavior in Ukraine further found evidence of a negative relationship between bank loan to capital ratio and macroeconomic uncertainty.

A review of the literature on the extent to which the likelihood of recession or recession probability influence bank performance found no empirical study that has specifically examined the relationship. We postulates that all things being equal, the likelihood of recession may generate some form of bank operational efficiency in the short run because of presumed rational need to shore-up operational structures to reduce vulnerability to recessionary shocks. In order words, the likelihood of recession though an adverse macroeconomic condition has the potential to exert positive impact on a bank's operational performance (NIM). However, the same macroeconomic condition (recessionary expectations) could have a negative impact on profitability indicators such as ROA, etc. in the long run.

4.4 General overview of bank profitability literature

Available literature presents significantly varied conclusions on factors explaining variability in bank profitability/performance. These factors as already alluded to span industry specific factors to conditions or factors in the general business or macroeconomic environment. For instance, in a recent empirical inquiry focusing on bank performance in China, Fang *et al.* (2019) showed that cost efficiency, profit efficiency, inflation and bank size are the main factors explaining variability in bank profitability. In addition, in a related study examining determinants of bank profitability in European Union, Petriaa *et al.* (2015) found that credit and liquidity risk, management efficiency, business diversification, competition and economic growth are the main factors having significant impact on bank profitability. In a similar study focusing on dynamics of bank profitability in Vietnam, Batten and Xuan Vinh Vo (2019) further concluded that both industry specific and macroeconomic factors tend to have significant effects on bank profitability. Aburime (2008), in an earlier study, reports that real interest rates, inflation, prevailing monetary policy and exchange rate regime are the significant factors explaining fluctuations in bank profitability in the Nigerian economy. A panel data study focusing on commercial banks in India by Al-Homaidi *et al.* (2018) further showed that variety of both industry specific and macroeconomic factors are the main determinants of commercial bank profitability. Kohlscheen *et al.* (2018), who examined core factors influencing bank profitability among emerging markets, concluded that bank profitability is positively related to bank specific credit growth and long-term interest rate; but negatively related to short-term interest rate. The study further noted the crucial role economic growth play in bank profitability. Sahyouni and Wang (2018) in a related study also alluded to the significant role of both industry specific factors and macroeconomic conditions play in explaining fluctuations in bank profitability. For instance, Sahyouni and Wang (2018) showed that asset management, bank size, capital ratio, credit quality and operating efficiency have divergent significant impact on bank profitability. This overview highlights spectrum of factors and conditions found to explain variability in bank profitability or performance. None of these studies, however, examined the three strands of inflation related conditions examined in the present study.

5. Data, variables and model specification

Empirical tests performed in this inquiry use data from the US Federal Reserve Economic database (Fred). Quarterly time series data used in subsequent empirical analysis span the

period between the first quarter of 1984 and the first quarter of 2016. The data are made up of the following variables; inflation (*Infl*), inflation expectations (*Inflexp*), inflation uncertainty (*Influnc*), recession expectations (*Recexp*) and macroeconomic uncertainty (*Macrounc*) as the main explanatory variables. Dependent variables capturing the US banking sector performance (namely, *ROA*, *ROE* and *NIM* are also sourced from the same database. With the exception of inflation uncertainty and macroeconomic uncertainty that are derived through an econometric process, all other variables exist as absolute indicators in the Fred database.

5.1 Deriving inflation uncertainty and macroeconomic uncertainty variables

Following studies such as Bekaert and Harvey (1997); Aggarwal *et al.* (1999); Akgül and Sayyan (2005); Gokbulut and Pekkaya (2014), inflation uncertainty and macroeconomic uncertainty variables are derived using generalized autoregressive conditional heteroskedastic framework *GARCH(1,1)* originally submitted by Bollerslev (1986) as a generalization of Engle (1982) ARCH framework. A GARCH procedure (an econometric process) captures fluctuations or volatility associated with a base variable as a measure of uncertainty; for instance, macroeconomic uncertainty variable is derived from the volatility associated with GDP growth. It is important to note that this process of deriving macroeconomic uncertainty from GDP growth is a well-accepted econometric procedure in the finance and economics literature. Using this econometric framework (*GARCH* (1,1), inflation uncertainty and macroeconomic uncertainty variables are modeled based on the following equation:

$$h_t = \omega + \alpha h_{t-1} \varepsilon_{t-1}^2 + \beta h_{t-1}. \quad (1)$$

Where h_t captures volatility associated with each base variables analyzed

To verify the extent to which noted macroeconomic conditions influence selected performance indicators over the period under consideration, we employ seemingly unrelated regression (SUR) framework in our empirical analysis. SUR framework is adopted because of the high likelihood of correlated error terms among the various explanatory variables employed in the study. Prior to this empirical test, however, a preliminary correlation matrix examining associations between key performance indicators and modeled macroeconomic conditions is presented.

5.2 Correlations analysis: macroeconomic conditions and bank performance indicators

Table 2 examine how various macroeconomic conditions correlates with key bank performance indicators in the US banking sector. This correlation analysis is meant to provide preliminary overview of the core relationships if any, between the various macroeconomic conditions and bank performance indicators. It is critical to point out that this correlation analysis only highlights the nature of association between the variables being examined and does not necessarily carry any potential causal inference; such determination is made in later empirical analysis using the SUR framework. The first three columns of Table 2 exhibits fundamental association between *ROA*, *ROE* and *NIM* and the various macroeconomic conditions.

Correlation results presented in the first three columns of Table 2 suggest that among the various macroeconomic variables examined, three have similar significant association with *ROA* and *ROE*. The results suggest that inflation expectations, inflation uncertainty and macroeconomic uncertainty tend to have significant association with *ROA* and *ROE*, respectively. Estimates on similar association between the various macroeconomic conditions and *NIM* show a slightly divergent outcome with inflation uncertainty,

macroeconomic uncertainty and inflation, rather than inflation expectations having significant association with NIM.

6. Macroeconomic conditions and the US banking sector performance: a SUR estimation analysis

6.1 Model specification: SUR estimation

To examine dynamic associations proposed earlier, this research employs SUR model. SUR framework features a generalization of basic linear regression model made up of multi-regression equations. Each of the equations in the framework has its own dependent variable and similar or varying sets of exogenous explanatory variables. The choice of this econometric procedure has been influenced by the likelihood of correlated error terms between modeled adverse macroeconomic conditions and selected bank performance indicators in an equation system. Seemingly unrelated regressions procedure allows for the estimation of such multiple equations simultaneously while accounting for correlated or potential correlated errors. The likelihood that various bank performance indicators might significantly reflect ebbs and flows of conditions in the broader business environment (macroeconomic conditions) increases the potential for the presence of correlated error terms; in such scenario, SUR framework has been found to be the best fit in handling such estimation process. In addition, it has been found that by combining information from different equations with correlated errors, some measure of efficiency in estimation is gained over a model like the ordinary least square. According to Moon and Perron (2006), one of the appealing features of the SUR framework is the ability to impose and/or test restrictions that involve parameters in different equations. Baltagi (2005) further suggests that when errors terms between systems of equations are correlated, the SUR estimator tends to be more efficient in analyzing relationships between variables in the system of equations.

The SUR model proposed by Zellner (1962) involves examining relationships among individual variables that are linked together by contemporaneous cross-equation error correlation. This SUR method employs sets of regression equations with cross-equation parameter restrictions and correlated error terms with differing variances. Following approach adopted by Tan and Floros (2014), projected associations between various macroeconomic conditions and banking sector performance indicators are estimated using the following equations:

$$ROA_t = \beta_0 + \beta_1 \text{Macrounc}_t + \beta_2 \text{Influnc}_t + \beta_3 \text{Recprob}_t + \beta_4 \text{Infexp}_t + \beta_5 \text{Infl}_t + \varepsilon_t \quad (2)$$

$$ROE_t = \lambda_0 + \lambda_1 \text{Macrounc}_t + \lambda_2 \text{Influnc}_t + \lambda_3 \text{Recprob}_t + \lambda_4 \text{Infexp}_t + \lambda_5 \text{Infl}_t + \varepsilon_t \quad (3)$$

$$\text{NIM}_t = \gamma_0 + \gamma_1 \text{Macrounc}_t + \gamma_2 \text{Influnc}_t + \gamma_3 \text{Recprob}_t + \gamma_4 \text{Infexp}_t + \gamma_5 \text{Infl}_t + \varepsilon_t \quad (4)$$

	ROA	ROE	NIM	Inflation	Infexp	Recprob	Influnc	Macrounc
ROA	1							
ROE		1						
NIM			1					
Infl	-0.057	0.0966	0.271**	1				
Infexp	-0.270**	-0.195*	-0.0696	0.580***	1			
Recprob	0.102	0.0816	-0.0716	0.184*	0.149	1		
Influnc	-0.267**	-0.285**	-0.204*	-0.238**	-0.125	-0.0456	1	
Macrounc	-0.453***	-0.442***	-0.236**	-0.168	-0.0913	-0.0599	0.687***	1

Note(s): * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (asterisks denotes levels of significance at various alpha levels)

Table 2.
Correlation matrix
(ROA, ROE, NIM and
macroeconomic
conditions)

Where t subscript captures the time dimension; $\beta_0, \lambda_0, \gamma_0$ represent the constant terms and $\beta_1, \dots, \beta_5, \lambda_1, \dots, \lambda_5$ and $\gamma_1, \dots, \gamma_5$ represent the various coefficients. Macrounc, influnc, recprob, inflexp and infl captures various macroeconomic conditions namely, macroeconomic uncertainty, inflation uncertainty, recessionary probability, inflation expectations and inflation. Finally, ROA, ROE and NIM captures the three performance indicators.

To examine how proposed macroeconomic conditions influence key dependent variables via the SUR method, we first examine stationary features of the various variables. This pre-estimation procedure helps in verifying whether time series or historical data employed in subsequent empirical analysis has stationary trend or otherwise; this distinction is crucial in enhancing the accuracy of final empirical results. In the following section, stationarity characteristics associated with individual variables are examined using both the augmented Dickey-Fuller unit root test and Dickey-Fuller generalized least square test, respectively.

6.2 Unit root tests

Unit root test examines stability or stationary conditions associated with time series variables. Results of these tests are presented in Table 3. In performing these tests, an optimum lag order for the estimation is first determined. Lag orders in this instance are estimated using both the Akaike information criterion (AIC) and Schwarz Bayesian information criterion (SBC) procedures. Augmented Dickey-Fuller (1981) (ADF) and the Dickey-Fuller generalized least square unit root tests proposed by (Elliott *et al.* (1996)) are conducted simultaneously to verify stationary characteristics of study variables. Unit root features of the various variables are examined using the following equation:

$$\Delta Z_t = \mu + \gamma Z_{t-1} + \sum_{j=1}^p \alpha_j \Delta Z_{t-j} + \beta t + \omega_t \tag{5}$$

Reported results suggest that most of the variables employed are stationary for the analysis to be performed in subsequent sections with few exceptions. Nonstationary variables in this instance are taking through the proper statistical procedure (differencing process) before the final empirical tests.

7. Effects of adverse macroeconomic conditions on the US banking sector performance

7.1 Empirical tests and result analysis

This section presents and analyzes empirical tests on the extent to which modeled adverse macroeconomic conditions influence key performance indicators associated with the US

Variables	Augmented Dickey-Fuller test			DF-GLS test	
	Optimum Lag order	Test Statistic	Results	DF-GLS Test stats	Results
Macrounc	1	-4.58***	I(0)	-4.99***	I(0)
Influnc	1	-9.13***	I(0)	-7.06***	I(0)
Recprob	1	-8.07***	I(0)	-7.60***	I(0)
Inflexp	1	-5.12***	I(0)	-4.84***	I(0)
Infl	1	-7.82***	I(0)	-7.16***	I(0)
Roa	1	-2.50***	I(1)	-2.07***	I(1)
Roe	1	-3.04***	I(0)	-2.52***	I(1)
Nim	1	-0.75***	I(1)	-1.30***	I(1)

Table 3.
Unit root test:
stationary analysis

Note(s): * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (asterisks denotes levels of significance at various alpha levels)

banking sector. Three equation systems (Eqs (2)–(4)) representing the three banking sector performance indicators are presented. SUR equations examining theorized interactions are examined based on these three equation systems. The first of these equation systems (1) from Table 4 test a scenario where ROA, ROE and NIM are examined simultaneously in one equation system with all the explanatory variables. The second system (2) test similar interactions in an equation system involving ROA, ROE and NIM; however, in this scenario an assumption that inflation and inflation uncertainty might not necessarily exist at the same time (a reflection of ongoing theoretical debate) is applied. Inflation uncertainty variable is omitted in this second equation system to ascertain if significant interaction effect exist in how the variables influence performance indicators. Suppressing the influence of inflation uncertainty variable in the second SUR system is based on an ongoing debate suggesting that a macroeconomic environment already characterized by inflationary pressures cannot be said to grapple with inflation uncertainty. The argument in support of this position stems from the assumption of rationality or rational behavior on the part of economic agents (investors, consumers, firms, etc). Rationality assumption advances that rational economic agents in a macroeconomic environment adjust behavior or operational activities to prevailing macroeconomic conditions using all available information. This adjustment process helps economic agents reduce uncertainty associated with prevailing macroeconomic conditions. In order words, in inflationary macroeconomic environment, economic agents will adjust and adapt to the prevailing condition, and in the process reduce the uncertainty associated with the condition or phenomenon. Consequently, inflation and inflation

	(1)	(2)	(3)
<i>ROA</i>			
Macrounc	-0.362*** (0.092)	-0.350*** (0.0613)	-0.364*** (0.0924)
Influnc	0.00919(0.053)		0.00412(0.0526)
Recprob	0.00252(0.003)	0.00277(0.0029)	0.00238(0.0033)
Inflexp	-0.269*** (0.0689)	-0.271*** (0.0680)	-0.237*** (0.0581)
Infl	0.0577(0.067)	0.0564(0.0665)	
_ cons	1.928*** (0.190)	1.933*** (0.188)	1.870*** (0.178)
R ²	0.3103	0.3103	0.3065
<i>ROE</i>			
Macrounc	-3.934*** (1.075)	-3.787*** (0.760)	-4.017*** (1.104)
Influnc	0.132(0.615)		-0.0513(0.628)
Recprob	0.0170(0.0378)	0.0201(0.034)	0.0119(0.0388)
Inflexp	-3.167*** (0.803)	-3.191*** (0.793)	-2.004** (0.694)
Infl	2.085*** (0.780)	2.069*** (0.776)	
cons_	21.56*** (2.216)	21.62*** (2.199)	19.46*** (2.129)
R ²	0.2905	0.2905	0.2514
<i>NIM</i>			
Macrounc	-0.196(0.116)	-0.190* (0.077)	-0.211(0.124)
Influnc	0.00491(0.067)		-0.0272(0.0708)
Recprob	-0.00220(0.0041)	-0.0021(0.0037)	-0.0031(0.0044)
Inflexp	-0.259** (0.0870)	-0.260** (0.0858)	-0.0548(0.0782)
Infl	0.366*** (0.0845)	0.365*** (0.0840)	
_ cons	4.480*** (0.240)	4.482*** (0.238)	4.112***
R ²	0.1896	0.1896	0.0719
N	129	129	129

Note(s): Standard errors in () * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (asterisks denotes levels of significance at various alpha levels)

Table 4.
Effects of adverse
macroeconomic
conditions on bank
performance

uncertainty may not necessarily prevail at the same time. In support of this position, Pourgerami and Maskus (1987) pointed out that in an environment of accelerating inflation, economic agents tend to invest more resources in inflation forecasting with the prime goal of reducing uncertainty. Finally, a third system (3) made up of ROA, ROE and NIM with all the adverse macroeconomic conditions with the exception of inflation is also tested. This final test is performed to ascertain effects of a reversal of the condition tested in the second equation system. An in-depth explanation of the rationale for the omission of the variables in scenarios two and three are presented in our analysis of estimated empirical results. Table 4 presents SUR coefficients estimates of how various adverse macroeconomic conditions examined in the study influence variability in bank performance indicators among the US banks.

7.2 Empirical analysis: adverse macroeconomic conditions and key performance indicators in the US banking sector

Empirical results presented in the first column of Table 4 are based on SUR equation system featuring three bank performance indicators and the various explanatory variables. Entire results presented in Table 4 suggest that significant differences exist in how various adverse macroeconomic conditions examined influence performance indicators in the US banking sector over the period examined. Coefficient estimates reported in the first column of Table 4, for instance, suggest that among the five macroeconomic conditions examined, only inflation expectations and macroeconomic uncertainty have significant influence on variability in ROA in the US banking sector over the study period. Both inflation expectations and macroeconomic uncertainty have negative influence on ROA. As surmised earlier, these negative results suggest that the two macroeconomic conditions have constraining effect on growth in ROA in the US banking sector; between the two macroeconomic conditions, however, macroeconomic uncertainty is found to have more constraining impact on ROA than inflation expectations all things being equal. In this same first scenario (first column of Table 4), inflation, recession probability/expectations and inflation uncertainty are found to be insignificant in explaining any form of variability associated with ROA; at least within the time frame being examined.

In the second part of the same SUR system (first column of Table 4), reported coefficient estimates further suggest similar association between the same two macroeconomic conditions and ROE. Estimated results suggest that these two adverse macroeconomic conditions have similar significant negative impact on ROE, but with a much greater constraining effect comparatively. Negative coefficients, in this instance, suggest the two macroeconomic conditions (macroeconomic uncertainty and inflation expectations) have encumbering effect on return on equity in the US banking sector. An in-depth analysis of the raw data on ROA and ROE suggests that ROE data are characterized by more volatility than ROA. It is thus probable to surmise that this characteristic might have contributed to the relatively high coefficient estimates associated with ROE. Presented coefficient estimates further suggest that once again macroeconomic uncertainty tends to have a much more constraining impact on ROE than inflation expectations holding all else constant. In addition to these two adverse macroeconomic conditions, our results also show that inflation has significant effects on ROE. Contrary to the nature of influence observed from the other two macroeconomic conditions, this result suggest prevailing inflationary conditions rather has positive impact on ROE in the US banking sector; a condition consistent with findings of Athanasoglou *et al.* (2005) and Flamini *et al.* (2009) respectively.

The last section of column 1 of Table 4 presents test results focusing on how modeled macroeconomic conditions affects net interest margins in the US banking sector. The results in this instance suggest that among the macroeconomic conditions examined, only inflation

expectations has significant positive impact on NIMs (a measure of operational efficiency). This positive coefficient to some degree suggests that firms in the US banking sector tend to enhance operational efficiency in anticipation of inflationary pressures; a condition, which reflects pre-emptive measures firms or banks ordinarily adopts in hopes of minimizing vulnerability to projected/anticipated adverse macroeconomic conditions.

Coefficient estimates presented in the second column (2) of Table 4 revolves around the assumption that inflation uncertainty may not constitute a threat to key economic agents or firms in a macroeconomic environment already characterized by inflationary conditions. Based on this contention, inflation uncertainty variable is omitted in this second stage of testing to ascertain effects of such omission on how bank performance indicators interacts with the remaining macroeconomic conditions. Coefficient estimates based on this assumption suggest that effects are similar to those presented in column 1 with minimal variations. Results in this instance suggest inflation expectations and macroeconomic uncertainty have significant (negative) constraining impact on ROA even in the absence of inflation uncertainty concerns. In addition, reported coefficient estimates further suggest that effects of modeled adverse macroeconomic conditions on ROE in the absence of inflation uncertainty are not significantly different from that of the first results presented in column 1 of Table 4. Coefficient estimates in this case suggest that unlike results from ROA, three out of the five macroeconomic conditions examined affects variability in ROE, with inflation again having divergent (positive) impact compared to macroeconomic uncertainty and inflation expectations. Negative coefficients in this regard indicate such macroeconomic conditions constrain growth in ROE. Results presented in the last part of column 2 of Table 4 examine how various macroeconomic conditions influence NIM in an environment devoid of inflationary uncertainty. On this test, we find that the omission of inflation uncertainty variable impacts how macroeconomic uncertainty affects NIM. The result shows that in the absence of inflation uncertainty, macroeconomic uncertainty variable becomes significant; with a negative or constraining impact on NIM. This outcome suggests that inflation uncertainty to some degree has significant interaction with macroeconomic uncertainty.

The final column (3) of Table 4 presents similar empirical results based on a three-tier SUR test procedure adopted in the first two; however, results reported in this column assumes a macroeconomic environment devoid of inflationary conditions. Coefficient estimates in this instance suggest that in the absence of actual inflationary conditions macroeconomic uncertainty and inflation expectations still have significant negative influence on ROA. This result affirms similar negative/constraining effects reported in the first two instances; however, a critical examination of the results further suggest that constraining effects of inflation expectations on the various performance indicators are minimal compared to the first two instances. Estimated results on the effects of various macroeconomic conditions on ROE on the other hand suggest that in an environment devoid of actual inflation pressures, negative/constraining effects of macroeconomic uncertainty tend to be relatively stronger; this is evidenced by a much higher coefficient of (-4.017) compared to coefficients from the first two scenarios (-3.934) and (-3.787) , respectively. In addition, the results further suggest that effects of inflation expectations on ROE also tend to diminish significantly in a macroeconomic environment not characterized by inflationary pressures. In the final part of column 3 where similar scenario is examined, the dominant interaction role of inflation becomes apparent. The results in this instance suggest that in the absence of inflationary condition, all other conditions examined become insignificant in explaining variability in NIM. This result to some extent builds on ongoing economic debate on the relationships among inflation, inflation expectations and inflation uncertainty. Presented empirical results suggest a significant link or association among these strands of inflationary conditions. The absence of inflationary condition in the last part of column 3 automatically negated effects of other strands of inflationary conditions in the test. This condition seems to support the view

that inflationary condition and inflation expectations may not prevail simultaneously in a macroeconomic environment. In other words, inflation expectations might not be an issue for an economy already experiencing inflation. In a seminal speech in support of this association, Bernanke (2004) alluded to this relationship by suggesting a significant nexus between inflation and inflation expectations. In a statement on the link between inflation and inflation expectations, Bernanke (2004) noted “An essential prerequisite to controlling inflation is controlling inflation expectations”; this statement to some extent suggests that realized or ongoing inflation has a significant relationship with inflation expectations. It further suggests that it may be an economic oddity for inflation expectations to be perceived as a problem in an environment already characterized by inflationary pressures. Our results on how omission of inflation influences how other variables influenced NIM in this instance support a known macroeconomic phenomenon about the interactions among these three strands of inflationary conditions.

From the above empirical results, it is evident that strands of inflationary conditions and other macroeconomic conditions such as those examined exerts varying significant effects on performance in the US banking sector. Test results further show that individual adverse macroeconomic conditions tend to have divergent impact on different bank performance indicators in different scenarios. Presented empirical results further support the notion that different banking sector performance indicators respond differently to adverse macroeconomic conditions; for instance, results presented in Table 4 suggest that ROE seems to be impacted more by macroeconomic uncertainty and inflation expectations than the ROA and NIM. The results also show that various adverse macroeconomic conditions examined seems to have less impact on net interest margin compared to ROA and ROE.

8. Conclusion and potential policy implications

This study examined effects of strands of related inflationary conditions and other macroeconomic conditions (macroeconomic uncertainty, inflationary uncertainty, recession probability, inflation expectations and inflation) on selected performance indicators in the US banking sector. Effects of various macroeconomic conditions on the US banking sector performance were examined empirically using SUR framework. Empirical results presented based on three test scenarios suggest that among adverse macroeconomic conditions examined, macroeconomic uncertainty and inflation expectations have significant negative impact on banking sector performance indicators at various alpha levels. For instance, in all three scenarios examined, we find that macroeconomic uncertainty and inflation expectations tend to constrain growth in both ROA and ROE in the US banking sector over the period examined. In addition, coefficients estimates further suggest that among bank performance indicators examined, macroeconomic uncertainty and inflation expectations have relatively much more constraining impact on ROE than the ROA and NIM. Again, empirical estimates presented in Table 4 also show that among the performance indicators examined, NIM is the variable least impacted by the various macroeconomic conditions examined.

Findings presented above could help inform strategic planning decisions pursued by institutions in the banking sector. For instance, some of the findings could inform policies and operational strategies geared toward reducing vulnerability associated with specific performance indicators such as ROE. This could be achieved by critically examining how individual performance indicators react to specific adverse macroeconomic condition. This process could help develop tailored measures or procedures focusing on reducing how susceptible key performance indicators are to the various adverse macroeconomic conditions. Other findings could also provide the platform for more adaptive policies aimed at minimizing effects of macroeconomic conditions on operational efficiency in the banking sector. Finally, we are of the view that further studies focusing on how other unexamined

adverse macroeconomic conditions such as equity market related uncertainty impacts banking sector performance could help strengthen the literature on how the banking industry reacts to adverse macroeconomic conditions.

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Relationship between slack resources and performance: temporal symmetry and duration of effects

Symmetry and duration of slack

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Received 3 October 2019
 Revised 13 February 2020
 Accepted 2 March 2020

Abstract

Purpose – Although slack resources and their relationship to performance have been widely studied in the literature, the temporal symmetry of this relationship, and the duration of its effects, are still unknown aspects and are the objective of this paper.

Design/methodology/approach – To evaluate this effect, an exploratory study has been designed on a sample of 449 Spanish industrial companies over a period of 12 years, assessing the impact of idle resources on economic and financial profitability. By means of hierarchical regressions, the short- term, medium- term and long-term effects of slack resources have been evaluated.

Findings – The results show that the impact on performance depends on the type of resource considered. Available slack has a consistent and positive effect on economic profitability in the short term. Other types of slack show persistent effects on performance, but, in the case of the recoverable slack, with a negative sign that contradicts the benefits provided by these resources. Finally, potential slack only has a permanent effect on financial profitability, but the sign changes depending on the economic context under consideration. There are also differences in the duration of the effects according to the type of resources.

Originality/value – This paper advances the knowledge about the slack-performance relationship over time that has been scarcely studied.

Keywords Performance, Slack, Timing, Industrial companies, Temporal symmetry

Paper type Research paper

1. Introduction

Penrose (1959) established that those companies that had slack resources would obtain superior results to those competitors that did not have access to them. Specifically, it stated that “unused productive services, for the company, are both a challenge to innovate, an incentive to expand, and a source for competitive advantage” (Penrose, 1960 p. 2). However, the literature that has studied the link between these resources and performance has not been able to reach conclusive results (Daniel *et al.*, 2004), although the latest review studies generally confirm a positive relationship between these two variables (Carnes *et al.*, 2019; Wan and Yiu, 2009). In any case, practically all research analyses this relationship following a transversal approach or, in the best of cases, considering a reduced number of years (Gral, 2014).

Consequently, a relevant question that still needs to be clarified is to know the mechanisms through which companies systematically transform and use slack resources in

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This research is developed in the research group GIRCO (Grupo de Investigación sobre Recursos y Capacidades Organizativas), founded by Ministerio de Economía y Competitividad de España (ECO2017-84364-R).



European Journal of Management
 and Business Economics
 Vol. 29 No. 3, 2020
 pp. 255-275
 Emerald Publishing Limited
 e-ISSN: 2444-8494
 p-ISSN: 2444-8451
 DOI 10.1108/EJMBE-10-2019-0177

pursuit of their objectives and goals (Kuusela *et al.*, 2017; Wan and Yiu, 2009). Among these mechanisms, time requirements for these resources to show measurable results for the organisation are particularly relevant (Argilés-Bosch *et al.*, 2018; Love and Nohria, 2005). This study of the temporal relationships between slack and performance is complicated by the multitude of partially contradictory or coincident classifications used, along with the absence of agreement on the appropriate way to measure slack (Carnes *et al.*, 2019).

The present work is an attempt to assess the impact that the slack resources have on performance over time. This research objective focuses on addressing the following research questions: (1) on the one hand, the duration of the effect of slack resources on performance, and (2) on the other, the existence of permanence of the relations between slack and performance over time. Regarding the duration, the paper aims to observe for how long the effect remains between a slack stock at any time and performance as different approaches have been used in the empirical literature (Argilés-Bosch *et al.*, 2018; Love and Nohria, 2005). With respect to the permanence of effects, it constitutes a subject of great relevance in any scientific discipline (Rosen, 2005), since it is a question of determining the temporal symmetry of the relations, that is to say if the link between slack and performance is contingent at the moment of time in which it is analysed.

In order to address these objectives, a longitudinal or temporal analysis is proposed, based on the information obtained from the annual accounts of 463 Spanish industrial companies over a period of 12 years (2006–2017). During this period of time, Spain suffered drastic changes in the munificence of the environment due to the financial crisis (Canto-Cuevas *et al.*, 2016), which has commonly been associated with the use or consumption of slack, what makes the single country sampling interesting. The balance sheet and profit and loss account allow estimating the most common indicators of slack resources that will be related to the economic and financial profitability of these companies.

The results obtained contribute to the existing knowledge both for the literature on slack resources and for business practice. From the theoretical point of view, the inclusion of time constitutes a relevant contribution insofar as most of the research on the subject is transversal or uses a relatively short period of time. From a practical perspective, the results show the disparate effect of the different types of slack, and, therefore, the conclusions establish recommendations for managers on the management of resource slack.

The article begins with a general review of the literature on slack resources, with special attention to the effect it has on business performance. After the presentation of the methodology used in the study, the results obtained are analysed. The work ends with conclusions and future lines of research.

2. Theoretical framework

Although the importance of slack resources and their definition goes back to the works of Cyert and March (1956), it was Bourgeois (1981) who established the guidelines for the current development of the concept and empirical analysis.

The literature on slack resources shows the opportunity they offer organisations to achieve their goals and objectives (Kuusela *et al.*, 2017; Sharfman *et al.*, 1988) or to face internal or external threats (Bourgeois, 1981; Vanacker *et al.*, 2017; Wan and Yiu, 2009). From a general perspective, there are three theoretical approaches that dominate the works: the resource-based view, the theory of organisational behaviour and the agency theory. On this basis, Bourgeois (1981) identifies a diversity of possible applications of this type of resources.

One of the most studied aspects of the role of slack resources is their effect on performance. However, and despite the number of investigations carried out (see, Gral, 2014 for a broad review), there is still no precise knowledge of how companies make use of these resources in order to achieve these higher returns (Daniel *et al.*, 2004; Tsang, 2006). Some recent studies

(Carnes *et al.*, 2019; Guo *et al.*, 2018; Leyva-de la Hiz *et al.*, 2019) have attempted to complete the model by introducing mediating variables into that relationship. However, the results are not conclusive and leave an opportunity to deepen their analysis.

Three different theoretical perspectives have dominated the slack–performance relationship. First, following the initial approach of Cyert and March (1963), it is understood that the possession of resources beyond what is necessary presents a positive effect on business performance. Thus, these resources contribute to the growth of the company through their use in reaching more ambitious goals (Penrose, 1959), although they can also serve as a cushion against adverse situations (Lee, 2011). Second, slacks have been considered to negatively affect performance (Ju and Zhao, 2009; Tan and Peng, 2003), as they are resources that have not been used for value-generation process and therefore present an opportunity cost. In addition, companies with this excess of resources may face internal tensions associated with agency problems (Phan and Hill, 1995). Finally, some authors suggest that these resources present positive or negative effects depending on the quantity. Thus, Bourgeois (1981) identifies that it is preferable to have a certain “cushion” of resources to undertake strategic projects but that, past a limit, these resources reflect inefficiency in management, assuming a curvilinear relationship (Chiu and Liaw, 2009; Tan, 2003).

Empirical studies have indiscriminately adopted these three perspectives without being able to reach a conclusion (Daniel *et al.*, 2004). One of the reasons for this lack of convergence in results is that there are many ways of understanding slack resources (Lecuona and Reitzig, 2014; Tang *et al.*, 2015), although most researchers seem to continue to raise and find a positive meaning to this relationship (Carnes *et al.*, 2019).

The different works that have tried to unify the existing literature (Carnes *et al.*, 2019; Daniel *et al.*, 2004; Gral, 2014) have shown that the effect on profitability varies according to the type of slack (Cheng and Kessner, 1997). The results seem to show recoverable resources as those with the least impact on performance (Daniel *et al.*, 2004). In the same way, the necessary capital intensity also features as a determining element at the time of understanding the effect (Sharfman *et al.*, 1988), making it necessary to control the industry. However, these results vary with the performance measure used (Gral, 2014).

The literature has also pointed to the need to apply controls when determining the impact of slack on performance, given the contingent nature of this relationship. In this way, uncertainty in the environment leads to a positive effect of the financial slack on performance. Faced with limited external resources, the positive impact becomes even stronger. In times or periods of crisis, the possession of slack initially results in a higher rate of decline in performance but allows for a faster speed of recovery in the post-recession period.

The consideration of the influence of the environment opens an interesting line of research, not yet explored. Studies on temporal symmetry (Rosen, 2005) try to determine whether a relationship between variables is maintained or changes at different times or periods of time, thus reflecting the effect that other variables or circumstances may have on that relationship. In short, the aim is to determine whether the relationship between slack and performance remains unchanged over time or whether the change in context, such as a crisis situation or a period of economic prosperity, influences that relationship.

Bearing in mind all these ideas, the paper, therefore, addresses the following research points. First, starting from a positive relationship between slack resources and performance, particularised according to the different types of slack that will be considered in this study. Second, this paper explores the possibility of a curvilinear relationship between these variables, following the ideas of Bourgeois (1981) and other authors (Love and Nohria, 2005; Wefald *et al.*, 2010). And third, the research tries to determine whether the relationships found, linear or curvilinear, are maintained in different periods of time, which are characterised by different economic contexts, either recession or expansion.

2.1 Time effect of slack resources

One of the least analysed issues, and with a great variety of results in the few analyses performed, is the temporal effect of the slack. It seems logical to propose the existence of an almost bidirectional relationship between resource slack and performance (Daniel *et al.*, 2004), given the dynamic and continuous nature of the company's operation. In this sense, both the accumulation of the slack and its use can present a delayed effect, since it is as much about the use of opportunities as the protection against threats, which do not have a temporal relation, *a priori*, between the resource, its accumulation and its use or orchestration.

Two different perspectives can be contemplated in the understanding of time. On the one hand, time can act as a contextualizing element. The reaction of companies in a period of economic crisis or in the evolution of a sector throughout its life cycle is an example of this perspective (Bradley *et al.*, 2011; Wan and Yiu, 2009; Zona, 2012). However, few studies have raised the possible symmetry of results over time (Dagostim Picolo *et al.*, 2018). On the other hand, time can be studied in relation to the durability of the effect of slack resources. In this case, the way in which companies use this "excess" of resources to reach their objectives is analysed (Guo *et al.*, 2018; Kuusela *et al.*, 2017), both in the speed of their consumption and in the prolongation of their effect in time (Love and Nohria, 2005).

When considering the relationship between slack resources and performance, it is necessary to bear in mind the dual role that performance plays. This accumulation will allow managers, according to the agency theory, to protect themselves against adverse situations that may occur in the future (Jensen, 1986). From a perspective centred on resources and capacities (Penrose, 1959), they are resources that can be orchestrated in order to make strategic decisions that favour obtaining a competitive advantage (Carnes *et al.*, 2019).

The few references to time in the literature (Argilés-Bosch *et al.*, 2018; Daniel *et al.*, 2004) have considered the possible delay in the effect of slack resources on performance, with effects lagged between 1 (Daniel *et al.*, 2004; Kuusela *et al.*, 2017) and 4 years (Love and Nohria, 2005), with the results not being significant in most cases.

3. Sample and methodology

This research uses the economic information contained in the financial statements to calculate the indicators. The data from the financial statements were collected by the SABI (Iberian Balance Sheet Analysis Systems) database covering the period from 2006 to 2017. This analysis period is justified as it covers the years prior to the economic crisis that began in 2008, and the subsequent years in which Spain was one of the most affected economies and their firms faced an environment with scarce resources and limited financial access (Canto-Cuevas *et al.*, 2016).

To guarantee, to a certain extent, the reliability of the information, those companies with a favourable audit report or a favourable audit report with qualifications in each and every one of the years of the period considered were selected, resulting in a total of 2,797 companies.

To reduce sectoral heterogeneity (Gral, 2014), the sample selected contains exclusively industrial companies (from NACE 20 to 38). Besides, companies that did not present complete information were discarded, reducing the sample to 449 companies.

The study has an exploratory character, because starting from a positive, linear or curvilinear (quadratic) relationship between slack and performance, it tries to determine the permanence in time (temporal symmetry) of this relationship, as well as the duration of the effect of the looseness of resources on the result of the company.

The Pearson correlation and the hierarchical linear regression were calculated using the SPSS software. These regressions were carried out, after checking the relevance of their estimation, in the successive years after the period considered and with delays, in order to determine the duration of the effects. A panel methodology was not used as it was a question

of determining the permanence of the relationship at different times, and not the consistency of that relationship throughout the whole period considered. Possible autocorrelation was evaluated by the Durbin–Watson test, with values around the adequate threshold for all regressions performed. Similarly, VIF values were below the value of 3 for all models tested in the paper.

3.1 Variables

With respect to dependent variables, the paper observes that the most common way of measuring profitability has been through economic profitability (ROA) (Carnes *et al.*, 2019). However, in order to obtain a more complete picture, following previous studies (see Daniel *et al.*, 2004), it was also decided to include financial profitability (ROE), as it reflects different objectives and management systems.

Consistent with previous studies, the paper uses financial ratios to calculate slack resources (e.g. George, 2005; Greenley *et al.*, 1998). Previous studies (Carnes *et al.*, 2019; Daniel *et al.*, 2004; Gral, 2014) indicate the need to consider the different types of slack (available, potential and recoverable), following the classification proposed by Bourgeois and Singh (1983), which continues to be the most used to date. Meta-analyses show how the current ratio (CR) (current assets/current liabilities) and the quick ratio (QR) (cash/current liabilities) are the most used ways to measure the available slack. Although the QR can be measured through other assets associated with liquidity, cash was considered for its immediacy (Deb *et al.*, 2017). For the other types of slack, the debt/equity (D/E) ratio was used to measure the potential, and the general sales and administrative expenses/sales ratio was used for recoverables. In this last category, the Spanish accounting system does not allow this type of expense to be identified by secondary data, so the analysis uses another of the most commonly used expenses, such as personnel expense/operating income (PE/I) (Lecuona and Reitzig, 2014; Paeleman; Vanacker, 2015).

After an initial evaluation, and observing the high values of collinearity between the CR and the QR, it was decided to use the first of them, which is the most used in the literature, thus facilitating greater comparability of results. All the variables were adjusted by subtracting the measure of each ratio from its industry, since it is common to compare the ratios in context in order to understand their effect (Paeleman *et al.*, 2017).

In order to control possible effects unrelated to the effect of slack resources, the following control variables were selected: the family nature of the company (George, 2005), international activity (exports, imports, both or none) (there is evidence of a relationship between slack resources and exports), whether or not the company is listed (George, 2005); the age of the company (logarithm of age) and, finally, the size of the company as measured by the logarithm of the number of employees (George, 2005).

4. Results

The interpretation of the results requires a differentiated analysis according to the dependent variable used (economic profitability and financial profitability), as well as the time horizon and the measurement of the slack. Regarding the period of time, the short term was considered as the immediate effect that the slack has on profitability; this is the approach followed by most of the literature, which has considered the effect of the slack on the profitability of the same year (Carnes *et al.*, 2019). For the medium term, an effect on the immediately subsequent year was considered, and for the long term, a period of 4 years was contemplated. These time horizons are arbitrary, but only respond to a manageable presentation of the results obtained; in the complete tables, the relations between slack resources and economic and financial profitability for the whole period considered are

included. Finally, three types of slack were considered: available, measured by the current ratio (CR); recoverable, measured through the personnel expenses / operating income (PE/I) relation; and potential, estimated by the quotient between debts and equity (D/E).

Table 1 presents the mean and standard deviation of the variables used in the analysis, as well as the correlation coefficients between them. It is observed that the economic and financial profitability of the different years selected is significantly related to some of the explanatory variables. The results of the regressions for those selected years are shown in Tables 2, 3 and 4.

4.1 Effect of different types of slack on economic profitability

In the short term, it can be observed that CR has a positive and significant effect for the years considered ($\beta = 2.947, p < 0.001$ for 2006; $\beta = 0.916, p < 0.01$ for 2010; and $\beta = 0.728, p < 0.01$ for 2013). When PE/I is analysed, a significant effect is also observed for the three years, but in this case, in a negative sense ($\beta = -0.19, p < 0.001$ for 2006; $\beta = -0.147, p < 0.001$ for 2010; and $\beta = -0.135, p < 0.001$ for 2013). On the other hand, the potential slack (D/E) presents a significant linear effect only for the year 2010 ($\beta = -0.073, p < 0.001$). Following the proposal put forward by the literature and associated with the efficiency of these resources and the possible existence of a curvilinear relationship between slack resources and profitability (Daniel *et al.*, 2004), the quadratic effects were studied, finding that the relationship shows a U-inverted shape for the CR in the years 2010 and 2013, as well as for D/E in the 2010 and 2013 periods.

For the medium term, that is, the effect in the immediately subsequent year, a negative and significant effect of recoverable slack on economic profitability is observed for the years 2007, 2011 and 2014 (for PE/I; $\beta = -0.155, p < 0.001$; $\beta = -0.077, p < 0.05$; and $\beta = -0.117, p < 0.01$). In the case of the available slack, a significant effect was observed in 2007, and with less significance also in 2014 (for CR; $\beta = 2.436, p < 0.001$ and $\beta = -0.534, p < 0.1$). With respect to the potential slack, only a significant effect is observed in 2011 (For D/E; $\beta = -0.042, p < 0.05$). Quadratic analyses show significant inverted U-shaped effects for CR of each year and for D/E in 2010 and 2013.

A possible long-term effect was also proposed, considering a delay period of 4 years. Although the literature has not considered such a long-term effect, the results show an effect between potential and recoverable slack through economic profitability, but only for 2013 (for D/E; $\beta = -0.642, p < 0.05$ and for PE/I; $\beta = -0.092, p < 0.01$).

4.2 Effect of different types of slack on financial performance

In the short term, there is a significant effect of the potential slack on financial profitability, although with a different sign depending on the year considered (for D/E; $\beta = 3.625, p < 0.001$ in 2006; $\beta = -7.152, p < 0.001$ in 2010; and $\beta = -5.569, p < 0.001$ in 2013). The effect is also significant in all years for the recoverable slack, but in this case, always with a negative sign (for PE/I; $\beta = -0.889, p < 0.001$ in 2006; $\beta = -0.833, p < 0.001$ in 2010; and $\beta = -0.347, p < 0.001$ in 2013). The effect of available resources (CR) is significant only in 2006 ($\beta = 5.265, p < 0.001$). No quadratic effects are observed for the available short-term slack in any of the years studied. The potential slack has a U-shaped relationship for 2006 and 2013, and inverted U for 2010 and 2014. On the other hand, the recoverable slack shows a U shape for 2006, without significant effect for the rest of the years.

In the medium term, it can be seen that potential slacks become relevant for 2006 and 2010 compared to the other two types of slack resources. Thus, the potential slack of 2006 has a significant and positive effect on the profitability of 2007 ($\beta = 15.987, p < 0.001$), and the 2010 slack on the financial profitability of 2011 ($\beta = 0.171, p < 0.01$). With regard to the PE/I ratio, there is a significant negative relationship between the 2010 slack and the 2011 financial

	Min	Max	Avg	SD	Family	Public	E/I	Age 06	Age 10	Age 13	Emp 06	Emp 10	Emp 13	CR 06	CR 10	CR 13	D/E 06	D/E 10	D/E 13	PE/I 06	PE/I 10	PE/I 13	ROA 06	ROA 10	ROA 13	ROE 06	ROE 10	ROE 13		
Family	0	1	0.43	0.50																										
Public	0	1	1.99	0.11	-0.122**																									
E/I	0	3	2.53	1.09	0.190**	-0.03																								
Age 06	8	57	25.78	16.15	0.06	-0.161**	0.08																							
Age 10	4	53	29.78	16.15	0.06	-0.161**	0.08	1.000**																						
Age 13	0	89	32.78	16.15	0.06	-0.161**	0.08	1.000**	1.000**																					
Emp 06	207	908	4.68	1.07	-0.269**	-0.08	-0.04	0.217**	0.217**	0.217**																				
Emp 10	160	931	4.64	1.02	-0.275**	-0.097*	-0.04	0.168**	0.168**	0.168**	0.948**																			
Emp 13	0	949	4.64	1.01	-0.311**	-0.02	-0.02	0.179**	0.179**	0.179**	0.910**	0.910**																		
CR 06	0.17	17.88	0.00	0.90	0.04	0.093*	0.02	0.05	0.05	0.05	-0.100*	-0.098*	-0.111*																	
CR 10	0.13	14.96	0.00	1.23	0.694*	0.109*	0.01	0.09	0.09	0.09	-0.125**	-0.143**	0.635**	0.815**																
CR 13	0.14	12.76	0.00	1.51	0.07	0.08	-0.02	0.09	0.09	0.09	-0.135**	-0.151**	0.549**	0.549**	0.815**															
D/E 06	-6.03	31.24	0.00	3.44	-0.02	0.01	0.01	-0.093*	-0.093*	-0.093*	0.04	0.05	0.08	-0.161**	-0.143**	-0.130**	0.428**													
D/E 10	-4.49	39.58	0.00	17.30	-0.03	0.01	0.02	0.02	0.02	0.02	0.05	0.03	0.09	-0.180**	-0.203**	-0.211**	0.165**	0.252**												
D/E 13	-29.50	44.23	0.00	2.32	-0.08	0.01	0.06	-0.02	-0.02	-0.02	0.04	0.04	0.04	0.05	0.03	0.03	-0.01	-0.02	-0.03											
PE/I 06	0.28	79.967	0.00	9.66	0.09	0.04	-0.07	0.063*	0.063*	0.063*	0.245**	0.178**	0.168**	0.09	0.05	0.03	0.06	0.097*	0.129**	0.782**										
PE/I 10	0.19	121.77	0.00	11.73	0.115*	-0.163**	-0.04	0.09	0.09	0.09	0.116*	0.109*	0.08	0.06	0.097*	0.129**	-0.04	-0.03	-0.07	0.782**										
PE/I 13	0.22	79.415	0.00	11.02	0.101*	0.01	-0.08	0.08	0.08	0.08	0.170**	0.165**	0.131**	0.135**	0.178**	0.209**	-0.06	-0.04	-0.11*	0.810**	0.810**									
ROA	-46.11	53.131	7.29	8.38	-0.108*	0.04	-0.04	0.01	0.01	0.01	-0.02	0.01	0.00	0.236**	0.223**	0.187**	-0.08	-0.06	-0.258**	-0.186**	-0.095*	-0.03								
ROE	-44.54	81.377	5.79	8.49	-0.07	0.06	-0.02	-0.05	-0.05	-0.05	-0.04	0.02	0.05	0.141**	0.101*	0.098*	-0.08	-0.145**	-0.108*	-0.06	-0.189**	-0.08	0.307**							
ROA	-58.65	47.244	4.63	8.42	-0.105*	-0.01	0.01	-0.07	-0.07	-0.07	-0.07	-0.03	0.01	0.09	0.01	0.09	-0.01	-0.03	-0.07	0.03	-0.05	-0.151**	0.167**	0.524**						
ROE 06	-258.15	514.02	19.33	33.45	-0.102*	0.03	-0.09	-0.116*	-0.116*	-0.116*	0.03	0.08	0.08	0.05	0.02	0.02	0.362**	0.00	-0.01	-0.231**	-0.166**	-0.137**	0.530**	0.267**	0.123**					
ROE 10	-247.14	138.89	3.27	13.75	0.05	0.00	0.03	-0.01	-0.01	-0.01	-0.05	-0.03	-0.07	0.02	0.01	-0.01	-0.319**	-0.922**	-0.177**	-0.01	-0.05	-0.01	0.09	0.260**	0.09	0.05				
ROE 13	-100.08	519.21	9.94	31.15	-0.104*	0.00	-0.09	-0.06	-0.06	-0.06	0.03	0.04	0.09	0.04	-0.05	-0.03	0.196**	0.182**	-0.378**	0.03	-0.03	-0.08	0.151**	0.219**	0.440**	0.120*	-0.07			

Note(s): *The correlation is significant at level 0.05 (bilateral). ** The correlation is significant at level 0.01 (bilateral).

Table 1. Correlation, average y standard deviation

Table 2.
2006 Regressions for
slack-performance
relationship

Slack Models	ROA (2006)		ROA (2007)		ROA (2010)		ROE (2006)		ROE (2007)		ROE (2010)			
	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2		
Cons	6.588 (8.211)	5.891 (7.752)	7.118 (7.847)	13.402 (7.737)	10.964 (7.69)	11.464 (7.957)	1.885 (8.336)	2.304 (8.348)	8.372 (29.525)	25.157 (26.064)	19.129 (121.632)	42.858 (110.954)	16.494 (131.81)	4.911 (126.625)
Family	-1.383* (0.854)	-1.415+ (0.81)	-1.454+ (0.809)	-1.224 (0.803)	-1.689 (0.828)	-1.224 (0.798)	-1.394 (0.867)	-1.248 (0.872)	-1.942 (3.083)	-1.776 (2.687)	-10.612 (12.656)	-11.26 (11.587)	9.043 (10.144)	9.033 (13.223)
Public	1.842 (3.848)	0.758 (3.621)	0.25 (3.64)	-3.296 (3.589)	-2.279 (3.591)	-3.296 (3.589)	3.406 (3.907)	2.692 (3.899)	4.932 (13.789)	1.88 (12.09)	-6.907 (67.002)	-15.067 (51.819)	0.901 (45.648)	4.02 (59.138)
E/I	-0.198 (0.371)	-0.381 (0.348)	-0.483 (0.353)	0.042 (0.359)	0.042 (0.345)	0.042 (0.348)	-0.01 (0.376)	-0.055 (0.375)	-3.113* (1.325)	-2.471* (1.172)	-1.976 (5.49)	-3.163 (4.979)	2.175 (4.424)	3.21 (5.682)
Age	0.016 (0.026)	0.006 (0.024)	0.001 (0.024)	-0.013 (0.024)	-0.019 (0.024)	-0.019 (0.024)	-0.013 (0.026)	-0.021 (0.026)	-0.149 (0.092)	-0.109 (0.08)	-0.82* (0.378)	-0.502 (0.344)	-0.301 (0.41)	-0.357 (0.389)
Tamaño	-0.44 (0.398)	0.264 (0.385)	0.368 (0.392)	0.471 (0.382)	-0.086 (0.386)	0.471 (0.386)	-0.409 (0.404)	-0.142** (0.415)	2.795+ (1.466)	-0.029 (1.301)	11.003+ (5.893)	8.3 (5.509)	-4.962 (6.386)	-2.835 (6.288)
CR06	2.947*** (0.422)	3.58 (0.626)	3.58 (0.626)	3.572*** (0.617)	2.436*** (0.418)	3.572*** (0.617)	1.284 (0.454)	1.436* (0.673)	5.265*** (1.606)	5.33* (2.08)	10.792+ (7.853)	4.185 (6.037)	-5.232 (6.889)	-10.19*** (10.082)
D/E06	-0.084 (0.109)	0.011 (0.12)	0.011 (0.12)	-0.017 (0.118)	0.029 (0.108)	-0.017 (0.118)	-0.154 (0.118)	-0.154 (0.118)	3.625*** (0.416)	2.032*** (0.397)	15.987*** (1.564)	9.292*** (1.501)	-12.752*** (1.785)	-10.19*** (1.927)
PE/I06	-0.19*** (0.04)	-0.191 (0.048)	-0.174 (0.048)	-0.174 (0.047)	-0.155*** (0.04)	-0.174 (0.047)	-0.054 (0.043)	-0.054 (0.043)	-0.889*** (0.152)	-0.524*** (0.158)	0.15 (0.573)	0.15 (0.598)	0.005 (0.654)	-0.75 (0.768)
2CR06	-0.008 (0.185)	-0.226 (0.185)	-0.226 (0.185)	-0.475** (0.182)	-0.475** (0.182)	-0.475** (0.182)	-0.105 (0.199)	-0.105 (0.199)	-0.836 (0.615)	-0.836 (0.615)	-0.118 (0.501)	-0.118 (0.501)	1.156 (2.979)	1.156 (2.979)
2D/E06	-0.008 (0.005)	-0.008 (0.005)	-0.008 (0.005)	0.006 (0.005)	0.006 (0.005)	0.006 (0.005)	0.012* (0.005)	0.012* (0.005)	0.181*** (0.016)	0.181*** (0.016)	0.699*** (0.06)	0.699*** (0.06)	-0.299*** (0.077)	-0.299*** (0.077)
2PE/I06	0 (0.002)	0 (0.002)	0 (0.002)	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)	0.001 (0.002)	0.001 (0.002)	-0.017** (0.006)	-0.017** (0.006)	-0.006 (0.024)	-0.006 (0.024)	0.039 (0.031)	0.039 (0.031)
R ² Adj	0.005	0.133	0.136	0.1	0.087	0.1	0.001	0.02	0.21	0.401	0.01	0.195	0	0.091

Note(s): Standard errors in parentheses; + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Slack Modelos	ROA (2010)		ROA (2011)		ROA (2014)		ROE (2010)		ROE (2011)		ROE (2014)	
	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2
Cons	-1.516 (8.462)	3.408 (8.261)	8.88 (7.728)	11.448 (7.732)	12.893 (8.407)	14.056 (8.503)	-3.604 (133.749)	-33.746 (51.187)	25.436 (22.734)	31.804 (22.627)	19.109 (37.816)	24.275 (38.265)
Family	-1.049 (0.87)	-0.76 (0.85)	-1.603* (0.794)	-1.456+ (0.795)	-3.553*** (0.864)	-3.476*** (0.875)	-3.355*** (13.743)	8.339 (5.265)	-2.289 (2.336)	-1.229 (2.327)	-1.216 (3.886)	-7.739* (3.936)
Public	3.878 (3.922)	0.55 (3.86)	1.787 (4.099)	-2.416 (3.613)	-2.149 (3.896)	-2.936 (3.972)	3.26 (61.984)	5.1 (23.915)	-3.668 (10.536)	-7.567 (10.571)	-10.638 (11.587)	-6.692 (17.878)
E/I	-0.01 (0.377)	-0.078 (0.365)	0.19 (0.344)	0.156 (0.342)	0.588 (0.374)	0.57 (0.376)	2.188 (5.954)	4.154+ (2.263)	-0.037 (1.012)	-0.308 (1)	1.402 (1.683)	-1.507 (1.691)
Age	-0.02 (0.026)	-0.024 (0.024)	-0.042+ (0.023)	-0.044+ (0.023)	-0.008 (0.025)	-0.008 (0.026)	0.087 (0.405)	0.081 (0.155)	-0.134+ (0.069)	-0.128+ (0.069)	-0.231* (0.115)	-0.237* (0.116)
Tamaño	0.145 (0.42)	0.539 (0.413)	0.721+ (0.384)	-0.247 (0.387)	0.518 (0.417)	-0.425 (0.425)	-1.499 (6.638)	2.412 (2.561)	-0.77 (1.128)	-0.474 (1.132)	-0.565 (1.158)	3.566+ (1.877)
CR10	0.916*** (0.325)	1.765*** (0.446)	0.484 (0.304)	1.022* (0.421)	0.451 (0.421)	0.202 (0.335)	0.561 (0.465)	-1.318 (2.015)	-0.943 (2.861)	-0.094 (0.891)	0.085 (1.259)	1.089 (1.506)
D/E10	-0.073*** (0.022)	-0.367*** (0.079)	-0.042* (0.021)	-0.31*** (0.074)	-0.308*** (0.023)	-0.017 (0.023)	-0.308*** (0.082)	-7.152*** (0.139)	-6.634*** (0.506)	0.171** (0.062)	-0.23 (0.223)	0.073 (0.104)
PE/I10	-0.147*** (0.034)	-0.17*** (0.041)	-0.077* (0.032)	-0.072+ (0.039)	-0.036 (0.035)	-0.036 (0.035)	-0.031 (0.043)	-0.833*** (0.213)	-0.924*** (0.262)	-0.262** (0.094)	-0.205+ (0.116)	-0.122 (0.159)
2CR10	-0.244*** (0.071)	0.001*** (0.071)	-0.175*** (0.067)	-0.175*** (0.067)	0.001*** (0.071)	0.001*** (0.075)	0.001*** (0.075)	-0.136+ (0.459)	0.028 (0.459)	-0.13 (0.202)	-0.13 (0.337)	-0.225 (0.337)
2D/E10	0.001*** (0)	0.001*** (0)	0.001*** (0)	0.001*** (0)	0.001*** (0)	0.001*** (0)	0.001*** (0)	0.001*** (0.002)	0.001*** (0.002)	0.001+ (0.001)	0.001+ (0.001)	0.004*** (0.001)
2PE/I10	0.001 (0.001)	0.001 (0.001)	0.007 (0.001)	0.025 (0.001)	0.028 (0.001)	0.025 (0.001)	0.000 (0.001)	0.003 (0.006)	0.003 (0.006)	-0.002 (0.003)	-0.002 (0.003)	0.006 (0.004)
R ² Adj	0.000	0.064	0.126	0.073	0.028	0.025	0.000	0.855	0.855	0.002	0.035	0.024

Note(s): Standard errors in parentheses; +p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001

Table 3. 2010 Regressions for slack-performance relationship

Table 4.
2013 Regressions for
slack–performance
relationship

Slack Models	ROA (2013)		ROA (2014)		ROA (2017)		ROE (2013)		ROE (2014)		ROE (2017)	
	M1	M2 (bis)	M1	M2 (bis)	M1	M2 (bis)	M1	M2 (bis)	M1	M2 (bis)	M1	M2 (bis)
Cons	11.699 (6.189)	10.744 (8.075)	10.616 (8.252)	9.646 (8.012)	5.924 (7.733)	6.368 (7.77)	18.593 (30.208)	8.921 (27.649)	15.195 (36.88)	10.985 (36.918)	17.364 (20.349)	10.237 (20.208)
Family	-1.974* (0.868)	-1.596+ (0.866)	-3.386*** (0.875)	-2.984*** (0.881)	-3.261*** (0.829)	-3.178*** (0.829)	-4.074 (3.203)	-4.65 (2.966)	-5.137+ (3.91)	-5.343 (3.96)	-4.826 (3.918)	-4.924* (2.168)
Public	-2.478 (3.851)	-2.984 (3.799)	-1.677 (3.88)	-1.962 (3.863)	1.9 (3.638)	1.697 (3.638)	-4.665 (14.203)	-2.165 (13.008)	-3.157 (12.862)	-5.784 (17.34)	-5.522 (17.203)	3.51 (9.508)
E/I	0.244 (0.372)	0.169 (0.369)	-0.058 (0.375)	0.492 (0.375)	0.472 (0.353)	0.499 (0.357)	-1.945 (1.373)	-1.458 (1.262)	-1.871 (1.261)	-1.825 (1.676)	-1.068 (1.686)	-0.672 (0.937)
Age	-0.036 (0.025)	-0.041 (0.025)	-0.046+ (0.026)	-0.013 (0.026)	-0.004 (0.024)	-0.001 (0.024)	-0.134 (0.094)	-0.129 (0.086)	-0.148+ (0.086)	-0.259* (0.115)	-0.103 (0.115)	-0.088 (0.063)
Tamaño	-0.147 (0.422)	0.315 (0.429)	-0.222 (0.426)	0.139 (0.436)	-0.534 (0.411)	-0.547 (0.41)	2.431 (1.558)	3.222* (1.469)	5.208** (1.902)	6.306*** (1.961)	6.479*** (1.941)	0.52 (1.078)
CR13	0.728** (0.275)	2.296*** (0.388)	0.534+ (0.28)	2.025*** (0.397)	-0.104 (0.264)	0.243 (0.385)	-1.31 (0.942)	-1.31 (0.942)	-0.8 (1.361)	1.268 (1.258)	2.271 (1.82)	-0.25 (0.689)
D/E13	-0.253 (0.173)	0.51* (0.24)	-0.042 (0.176)	-0.042 (0.176)	-0.642* (0.165)	-0.642* (0.238)	-0.522 (0.592)	-3.41*** (0.841)	-0.522 (0.79)	-2.685* (1.125)	-0.502 (1.125)	-0.395 (0.432)
PE/I13	-0.135*** (0.037)	-0.148*** (0.041)	-0.117** (0.038)	-0.139*** (0.042)	-0.092** (0.066)	-0.085* (0.041)	-0.085* (0.041)	-0.347** (0.128)	-0.385* (0.146)	-0.385* (0.171)	-0.54** (0.194)	-0.388*** (0.108)
2CR13		-0.333*** (0.066)		-0.316*** (0.067)		-0.099 (0.065)		0.024 (0.23)		-0.361 (0.307)		-0.114 (0.171)
2D/E13		-0.049* (0.013)		-0.046* (0.013)		0.019 (0.013)		-0.167*** (0.045)		0.169** (0.06)		-0.005 (0.033)
2PE/I13		0.001 (0.002)		0.001 (0.002)		0		0.006 (0.005)		0.013+ (0.007)		-0.000 (0.004)
R ² Adj	0.006	0.042	0.025	0.043	0.067	0.071	0.024	0.171	0.034	0.04	0.02	0.054

Note(s): Standard errors in parentheses; +p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001

return ($\beta = -0.262, p < 0.01$), and also between the 2013 slack and the 2014 return ($\beta = -0.385, p < 0.01$). The quadratic analyses show a U shape for the potential in the 2006 D/E and a U-inverted shape in the 2013 D/E, as well as a U-inverted shape for the recoverable in the year 2013, although with low significance.

Finally, in the long term, significant relationships are scarce, but there is an effect of the potential slack of 2006 on the financial profitability of 2010 ($\beta = -12.752, p < 0.001$) and of the recoverable slack of 2013 ($\beta = -0.388, p < 0.001$) on the profitability of 2017. In the first case, there is also a U-shaped relationship between potential slack in 2006 and profitability in 2010; this relationship is also observed between 2010 and 2014.

4.3 Analysis of the robustness of the results and duration of the effects

In addition to the previous analyses, which have estimated the linear and quadratic effects of the control and explanatory variables for three discretionally chosen years (2006, 2010 and 2013), a robustness analysis has been carried out comparing the different types of slack and the performance for all the years of the period considered. This analysis makes it possible to determine the degree of permanence in time, or temporal symmetry, of the relationships found. The results can be seen in Tables 5 and 6, which show the coefficients, deviations and level of significance of these effects.

Observing the short-term effect (values of the main diagonal), it is possible to verify that the ratio of both the available slack (CR) and the recoverable slack (PE/I) to the economic profitability occurs in all the years of the period, one in the positive and the other in the negative. It can therefore be said that there is a certain temporal symmetry in these relationships. This feature is not observed in the short-term relationship between D/E and economic profitability, as it is only significant in 4 out of the 12 estimated regressions. This is an expected result, taking into account the longer-term nature or potential effect of these resources.

In the medium term, the relationship between the recoverable slack and economic profitability persists, since in all the years considered it is significant and negative. On the contrary, this relationship is less permanent in the cases of available and potential slacks, which is significant only in 5 and 4 cases, respectively, out of 11 estimated ratios.

Finally, in the long term (delayed effect of 4 years), the relations between the variables are less persistent. Thus, the effects of the three types of slack on the economic profitability are produced in scarce relations, since only in 2 cases out 8 possible ones the three types of slack have a significant effect. This result indicates that the impact of the slack on the performance is less visible and permanent when it is removed in time.

In order to statistically confirm these observations, a *lincom* estimation was carried out using Stata 12 software, as it offers a confidence interval as well as a null hypothesis test on whether the difference between the coefficients is zero, that is, whether the intensity and the sign remain over time. The results show that in the regression on economic profitability, the coefficients are significantly different from the CR in the first two years analysed, but show homogeneity in intensity and sign for the rest of the period. For the other two slack ratios analysed, the results show a predominance of equality (only 7 out of 66 comparisons were significant for the D/E and 10 out of 66 for the PE/I), without observing a pattern in the relations.

Regarding financial profitability, in the short term, the effect of the recoverable slack (11 significant and negative relationships out of 12 possible) and the potential slack (9 significant and mostly negative relationships) is permanent, but not so in the available slack, where only two significant relationships are identified. In the medium term, the permanence of the effects decreases, although it remains high in the case of the potential slack (8 significant relationships and mostly positive out of 11 possible) and less in the recoverable slack (6 significant and negative relationships). As in the short term, the available slack does not show

Table 5.
Analysis of temporal
symmetry (ROA)

	ROA06	ROA07	ROA08	ROA09	ROA10	ROA11	ROA12	ROA13	ROA14	ROA15	ROA16	ROA17	
Slack2006	CR	2.947*** (0.421)	2.436*** (0.418)	1.618*** (0.465)	1.091 (0.675)	1.284*** (0.454)	0.253 (0.415)	0.176 (0.507)	0.766+ (0.450)	0.625 (0.455)	-0.155 (0.579)	0.665 (0.650)	-0.066 (0.429)
	D/E	-0.084 (0.109)	0.029 (0.108)	-0.191 (0.120)	0.035 (0.174)	-0.154 (0.117)	-0.296*** (0.107)	-0.234+ (0.131)	-0.012 (0.116)	0.132 (0.117)	-0.109 (0.150)	0.177 (0.168)	-0.300*** (0.111)
	PE/I	-0.190*** (0.040)	-0.153*** (0.039)	-0.158*** (0.044)	-0.116+ (0.064)	-0.064 (0.043)	0.012 (0.039)	-0.015 (0.048)	0.061 (0.042)	0.022 (0.043)	-0.018 (0.054)	-0.033 (0.061)	-0.050 (0.040)
Slack2007	CR	2.415*** (0.381)	2.415*** (0.381)	1.517*** (0.433)	0.987 (0.624)	1.182*** (0.420)	0.722+ (0.386)	0.466 (0.470)	0.736+ (0.415)	0.405 (0.421)	0.453 (0.535)	0.638 (0.601)	-0.187 (0.399)
	D/E	0.130* (0.063)	0.130* (0.063)	0.054 (0.072)	0.087 (0.104)	0.091 (0.070)	-0.020 (0.064)	0.044 (0.078)	0.133+ (0.069)	0.086 (0.070)	0.017 (0.089)	0.118 (0.100)	-0.095 (0.066)
	PE/I	-0.149*** (0.039)	-0.146*** (0.039)	-0.146*** (0.045)	-0.104 (0.065)	-0.050 (0.043)	-0.014 (0.040)	-0.013 (0.049)	0.059 (0.043)	0.025 (0.043)	-0.011 (0.055)	-0.016 (0.062)	-0.050 (0.041)
Slack2008	CR			0.710*** (0.212)	0.255 (0.311)	0.255 (0.210)	0.132 (0.193)	0.085 (0.234)	0.055 (0.208)	0.089 (0.210)	0.013 (0.266)	0.215 (0.300)	-0.146 (0.198)
	D/E			-0.149*** (0.049)	0.013* (0.072)	-0.091 (0.049)	-0.044 (0.045)	-0.054 (0.054)	0.097* (0.048)	0.009 (0.049)	0.090 (0.062)	0.079 (0.070)	-0.097* (0.046)
	PE/I			-0.205*** (0.041)	-0.138* (0.061)	-0.076+ (0.041)	-0.042 (0.037)	-0.055 (0.046)	0.027 (0.040)	0.002 (0.041)	-0.034 (0.052)	-0.032 (0.058)	-0.060 (0.038)
Slack2009	CR			0.361 (0.325)	0.568+ (0.325)	0.361 (0.222)	0.258 (0.203)	0.156 (0.249)	0.037 (0.222)	-0.046 (0.224)	0.028 (0.284)	0.184 (0.319)	-0.218 (0.211)
	D/E			0.059+ (0.051)	0.061 (0.051)	0.059+ (0.035)	0.052 (0.032)	0.013 (0.039)	0.027 (0.035)	-0.008 (0.045)	0.034 (0.045)	0.070 (0.050)	0.001 (0.033)
	PE/I			-0.123*** (0.036)	-0.225*** (0.053)	-0.083* (0.033)	-0.083* (0.033)	-0.077+ (0.040)	-0.024 (0.036)	-0.027 (0.036)	-0.058 (0.046)	-0.068 (0.052)	-0.061+ (0.034)
Slack2010	CR			0.916** (0.325)	0.484 (0.304)	0.916** (0.325)	0.484 (0.304)	0.381 (0.372)	0.178 (0.332)	0.202 (0.334)	0.335 (0.424)	0.439 (0.477)	-0.139 (0.316)
	D/E			-0.073*** (0.034)	-0.073*** (0.034)	-0.073*** (0.034)	-0.042* (0.021)	-0.028 (0.025)	-0.013 (0.022)	-0.017 (0.023)	-0.019 (0.029)	0.001 (0.032)	-0.025 (0.021)
	PE/I			-0.147*** (0.034)	-0.147*** (0.034)	-0.147*** (0.034)	-0.077** (0.032)	-0.076+ (0.039)	-0.028 (0.035)	-0.036 (0.035)	-0.073 (0.044)	-0.062 (0.050)	-0.078* (0.033)
Slack2011	CR			0.635** (0.232)	0.221 (0.257)	0.635** (0.232)	0.221 (0.257)	0.221 (0.257)	0.295 (0.255)	0.263 (0.257)	0.219 (0.328)	0.331 (0.368)	0.004 (0.243)
	D/E			-0.117* (0.045)	-0.117* (0.045)	-0.117* (0.045)	-0.117* (0.045)	-0.050 (0.056)	0.011 (0.050)	0.006 (0.050)	0.010 (0.064)	0.038 (0.072)	-0.091 (0.048)
	PE/I			-0.104** (0.033)	-0.104** (0.033)	-0.104** (0.033)	-0.089* (0.033)	-0.089* (0.041)	-0.035 (0.037)	-0.085+ (0.037)	-0.072 (0.047)	-0.053 (0.053)	-0.085*1 (0.035)

(continued)

	ROA06	ROA07	ROA08	ROA09	ROA10	ROA11	ROA12	ROA13	ROA14	ROA15	ROA16	ROA17
Slack2012												
CR							0.400 (0.254)	0.295 (0.255)	0.306 (0.325)	0.453 (0.366)	-0.141 (0.241)	
D/E							0.575* (0.282)	0.195 (0.155)	0.319* (0.155)	0.375+ (0.198)	-0.486*** (0.146)	
PE/I							-0.166*** (0.041)	-0.067+ (0.037)	-0.093* (0.047)	-0.107* (0.053)	-0.079* (0.035)	
Slack2013							0.728** (0.275)	0.534+ (0.279)	0.401+ (0.355)	0.725+ (0.400)	-0.104*** (0.263)	
CR							-0.253 (0.172)	-0.042 (0.175)	-0.405 (0.223)	-0.042 (0.251)	-0.642 (0.165)	
D/E							-0.135*** (0.037)	-0.117** (0.037)	-0.151** (0.048)	-0.143** (0.054)	-0.092** (0.035)	
PE/I								0.470+ (0.251)	0.221 (0.319)	0.506 (0.360)	-0.141 (0.235)	
Slack2014								-0.158 (0.150)	-0.406* (0.191)	-0.038 (0.215)	-0.607*** (0.141)	
CR								-0.119** (0.039)	-0.153** (0.050)	-0.146** (0.056)	-0.104** (0.037)	
D/E									0.873** (0.286)	0.642+ (0.334)	-0.137 (0.219)	
PE/I									0.027 (0.152)	0.099 (0.178)	-0.551*** (0.116)	
Slack2015									-0.321*** (0.045)	-0.1165** (0.052)	-0.1165** (0.034)	
CR										1.124** (0.354)	0.156** (0.236)	
D/E										0.084 (0.242)	-0.446 (0.162)	
PE/I										-0.203*** (0.054)	-0.149*** (0.036)	
Slack2016												
CR												
D/E												
PE/I												
Slack2017												
CR												
D/E												
PE/I												

Note(s): Standard errors in parentheses; + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5.

Table 6.
Analysis of time
symmetry (ROE)

	ROE06	ROE07	ROE08	ROE09	ROE10	ROE11	ROE12	ROE13	ROE14	ROE15	ROE16	ROE17	
Stack2006	CR	5.265*** (1.606)	10.792+ (6.036)	14.151* (5.766)	-2.509 (6.959)	-5.830 (6.889)	-1.098 (1.230)	2.970 (1.904)	2.736+ (1.644)	6.237*** (1.865)	3.692 (2.518)	7.681** (2.452)	0.181 (1.076)
	D/	3.625*** (0.416)	15.987*** (1.563)	8.126*** (1.494)	3.024+ (1.802)	-12.752*** (1.784)	-0.167 (0.318)	0.803 (0.493)	1.855*** (0.426)	4.676*** (0.483)	3.154*** (0.652)	7.777*** (0.635)	1.764*** (0.278)
	PE/	-0.889*** (0.152)	0.150 (0.573)	-1.290* (0.547)	-0.383 (0.660)	0.005 (0.653)	-0.199+ (0.116)	-0.383* (0.180)	0.091 (0.156)	0.041 (0.177)	-0.680** (0.239)	-0.315** (0.102)	-0.315** (0.102)
	I		-3.901 (6.026)	-1.774 (5.466)	-4.109 (6.444)	2.872 (6.683)	-0.236 (1.136)	2.215 (1.715)	1.776 (1.530)	3.158+ (1.836)	1.193 (2.369)	2.308 (2.465)	-1.126 (1.018)
Stack2007	CR		-5.193*** (1.009)	2.571** (0.915)	0.932 (1.079)	-2.545* (1.119)	1.485*** (0.190)	1.485*** (0.287)	0.949*** (0.256)	1.736*** (0.307)	1.181** (0.396)	3.186*** (0.412)	0.753*** (0.170)
	D/		-0.378 (0.627)	-0.881 (0.569)	-0.508 (0.671)	-0.887 (0.696)	-0.196+ (0.118)	-0.245 (0.178)	0.132 (0.159)	0.179 (0.191)	-0.507* (0.246)	-0.056 (0.256)	-0.225* (0.106)
	E		0.603 (2.683)	0.603 (2.683)	-1.641 (3.198)	0.185 (2.568)	0.048 (0.547)	0.837 (0.868)	0.333 (0.751)	0.744 (0.928)	0.874 (1.151)	0.951 (1.252)	-0.279 (0.503)
	PE/		-1.444** (0.526)	-2.792*** (0.626)	1.544* (0.747)	-10.521*** (0.599)	0.684*** (0.127)	0.731*** (0.202)	0.946*** (0.175)	0.996*** (0.216)	1.503*** (0.268)	1.864*** (0.292)	0.590*** (0.117)
	I				-0.640 (0.627)	-1.305** (0.504)	-0.240* (0.107)	-0.351* (0.170)	0.059 (0.147)	0.046 (0.182)	-0.517* (0.226)	-0.233 (0.245)	-0.269** (0.098)
Stack2009	CR				-2.218 (2.765)	1.407 (3.572)	0.020 (0.600)	0.305 (0.929)	-0.117 (0.820)	0.536 (1.007)	-0.171 (1.268)	0.708 (1.385)	-0.682 (0.550)
	D/				-6.667*** (0.438)	0.012 (0.566)	0.154 (0.095)	0.374* (0.147)	0.294* (0.130)	0.248 (0.159)	0.314 (0.201)	0.344 (0.219)	0.046(0.087)
	E				-1.055* (0.452)	-0.327 (0.584)	-0.264** (0.098)	-0.402** (0.151)	-0.098 (0.134)	-0.116 (0.164)	-0.473* (0.207)	-0.414+ (0.226)	-0.273** (0.090)
	PE/					-1.318 (2.014)	-0.094 (0.890)	0.193 (0.386)	-0.493 (1.210)	0.864 (1.505)	-0.970 (1.891)	1.613 (2.073)	-0.758 (0.820)
	I					-7.152*** (0.139)	0.171** (0.061)	0.253** (0.095)	0.325*** (0.083)	0.073 (0.104)	0.151 (0.130)	0.075 (0.143)	0.002 (0.056)
Stack2010	CR					-0.833*** (0.212)	-0.262** (0.094)	-0.369* (0.146)	-0.055 (0.127)	-0.122 (0.159)	-0.494* (0.199)	-0.355 (0.219)	-0.307*** (0.086)
	D/						0.241 (0.690)	0.192 (1.028)	-0.346 (0.933)	0.544 (1.455)	-0.292 (1.455)	1.044 (1.594)	-0.233 (0.630)
	E						0.032 (0.136)	1.292*** (0.202)	0.698*** (0.184)	0.576* (0.226)	0.265 (0.286)	0.339 (0.314)	-0.125 (0.124)
	PE/						-0.328*** (0.100)	-0.335* (0.149)	-0.015 (0.135)	-0.121 (0.167)	-0.576** (0.211)	-0.403+ (0.231)	-0.369*** (0.091)
Stack2011	CR												

(continued)

	ROE06	ROE07	ROE08	ROE09	ROE10	ROE11	ROE12	ROE13	ROE14	ROE15	ROE16	ROE17
Slack2012	CR						0.730 (1.062)	-0.493 (0.942)	1.117 (1.147)	-1.517 (1.403)	1.821 (1.579)	-0.407 (0.628)
	D/						-0.471 (0.647)	-0.923 (0.573)	1.496* (0.698)	-4.784*** (0.854)	2.301* (0.961)	-0.592 (0.382)
	E/											
	PE/						-0.587*** (0.154)	-0.153 (0.137)	-0.250 (0.167)	-0.652** (0.204)	-0.479* (0.230)	-0.353*** (0.091)
	I											
Slack2013	CR											
	D/											
	E/											
	PE/						-5.369*** (0.942)	-0.522 (0.789)	-5.210*** (1.258)	2.795** (0.966)	2.795** (1.081)	-0.502 (0.432)
	I											
Slack2014	CR											
	D/											
	E/											
	PE/						-0.347** (0.127)	-0.385* (0.170)	-0.743*** (0.209)	-0.598* (0.233)	-0.598* (0.233)	-0.388*** (0.093)
	I											
Slack2015	CR											
	D/											
	E/											
	PE/											
	I											
Slack2016	CR											
	D/											
	E/											
	PE/											
	I											
Slack2017	CR											
	D/											
	E/											
	PE/											
	I											

Note(s). Standard errors in parentheses; + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6.

a permanent effect on financial profitability. Finally, in the long term (4 years of delay in the effects), the relations are less permanent, although, in the case of both the potential and recoverable slack, 4 significant relations are observed out of 8 possible results. The lincom post-estimation test indicates a relative symmetry in the estimated relations.

The results also allow exploring the duration of the effect of slack resources on performance. Despite not showing a clearly identifiable general pattern, they show certain trends that need to be highlighted. Thus, the recoverable slack (PE/I) has the longest impact, particularly on economic profitability, since in all the years considered, this type of slack has (negative) effects on profitability. The duration of the effect is reduced in the central years of the period, but increases again in the final years. Effects are not so lasting for the other two types of slack. For financial profitability, both potential and recoverable slacks have a certain duration of effects, but only in certain years. In all cases, the ratios of the coefficients decrease as they move away in time.

In summary, the multiple results obtained allow us to identify patterns regarding the effects of the slack on performance, taking into account the persistence of the relationships and the duration of the impacts. Thus, the available slack (CR) has a positive short-term effect on the economic profitability that remains in time. The potential slack (D/E) has a persistent short-term impact on financial profitability, although, in this case, the sign of the relationship changes according to the year in question. Finally, the recoverable slack (PE/I) has a permanent and negative short-term effect on both economic and financial profitability. There is also a permanent and negative medium-term effect between recoverable slack and economic profitability. There is no significant pattern in the long term. With regard to the duration of the effects, a lasting effect is only observed in the case of recoverable slacks, especially in the case of economic profitability, although the prolongation in time of the impact changes according to the years.

5. Discussion, conclusion, implications and limitations

Meta-analyses have revealed a positive relationship between slack resources and performance (Daniel *et al.*, 2004; Carnes *et al.*, 2019). However, effects vary according to the type of slack, the measurement of performance and other contingent variables, such as the sector or the nature of the company. Differences between the studies, although significant, can be explained by the contexts used rather than by deep theoretical differences (Carnes *et al.*, 2019). Based on these ideas, the objective of this study has been to analyse the permanence of these relationships over time, as well as the duration of the effects, taking into account different types of slack and different measures of performance. The results obtained provide interesting conclusions that allow advancing the knowledge of the role of slack resources on performance.

The analysis covers 12 years (2006–2017) comprising periods of economic prosperity, recession and recovery. Results show numerous significant results, but many respond to short-term or contingent effects at a given time, to a type of slack or to a performance measure. In this discussion, we are only interested in those significant results that remain over time and give rise to clearly identifiable patterns.

The available slack, measured through the current ratio (CR), has a positive short-term effect on economic profitability in all the years analysed. This impact is significantly more intense in the first two years, showing that companies use these resources more aggressively and with greater complexity (Carnes *et al.*, 2019) in periods of economic prosperity. In other stages of the cycle, the available slack continues to have a significant and positive effect, although with lower coefficients. There are no significant relationships between this type of slack and profitability in the medium and long term, showing that companies use these resources immediately, something to be expected bearing in mind that their measurement is

made through magnitudes of current assets, and, therefore, linked to the short-term activity of the company.

The effect of the available slack is produced exclusively on the economic profitability and not on the financial one, indicating that this relation is contingent to the performance measure used. It is a resource of operational nature, related to the short-term operating or ordinary profit of the company. Consequently, this type of slack reflects the ease and flexibility of its operational use to face both internal and external fluctuations and thus ensure the companies' performance (Cyert and March, 1956; Sharfman *et al.*, 1988).

The recoverable slack shows a significant, negative and permanent effect, in the short and medium term, on both economic and financial profitability. This persistently negative effect is consistent with the one found by Carnes *et al.* (2019, p. 76). The negative relationship indicates that the inefficiency hypothesis (Ju and Zhao, 2009; Tan and Peng, 2003) takes precedence over the advantage of having slacks, that is, that the higher costs compensate for the benefits of recovering and deploying this type of slack (Carnes *et al.*, 2019). Certainly, retaining excess workers or paying higher wages may allow the company to have greater tacit knowledge and skills that can be used in times of need, but the results show that these slack resources really represent inefficiencies rather than knowledge retention and flexibility (Lecuona and Reitzig, 2014) and are often used in order to improve performance (Sánchez and Suárez, 2005).

It is surprising that this effect occurs throughout the period considered and both in the short and medium term, reflecting that in each year, the most inefficient companies in the use of their human resources obtain lower economic and financial returns than other companies. The analysis makes it possible to ensure that companies with recoverable human resource slack in a given year do not use this excess to obtain higher returns in subsequent years, as no long-term effects on performance are observed.

Finally, the potential slack has an effect mainly, or almost exclusively, on financial profitability. This result reflects that the relationship is due not only to the use of the slack but also to the financial strategy of the company, in this case, the use of financial leverage, in which the effects of the interest and tax rate have a special relevance. The direction of the relationship changes according to the period of time considered, a result similar to that obtained by Carnes *et al.* (2019, p. 76) in their meta-analysis: "the finding that potential slack negatively affects short-term performance but positively affects long-term performance reflects utilization differences".

The results, when considering a wide time horizon, show that the relationship between potential slack and performance is more complex than that obtained by other studies, since that negative relationship on short-term profitability and positive long-term performance changes according to the economic context considered. Thus, during economic growth, relationships similar to those indicated by Carnes *et al.* (2019) are obtained, but this relationship is inverted in periods of recession or crisis (positive in the short term, and sometimes negative in the medium and long term). These differences reflect the various possibilities that slacks offer companies, depending on their nature and the circumstances. In periods of crisis, companies must use their possible financial slacks to ensure their survival, facing the external fluctuations they must face (Cyert and March, 1956). Hence, there is positive relationship in the short and medium term between potential slack and performance, with no long-term relationship observed in those slacks. On the contrary, in periods of growth, the slack may have a more strategic character (Bourgeois, 1981), and, therefore, the relationship with performance will be in the longer term, while in the short term, an excess of potential slack indicates that the company is not sufficiently leveraging its financial structure (Carnes *et al.*, 2019).

The study also explored the possibility of a curvilinear relationship between slack and performance (Bourgeois, 1981; George, 2005) reflecting an inefficiency in management. The

results obtained confirm this curvilinear relationship (Chiu and Liaw, 2009; Tan, 2003), but with differences according to the types of slack and periods considered. The inverted U-shaped relationship is relatively consistent between available slack and economic profitability, especially in periods of crisis, reflecting the need to fine-tune the use of this type of resource. There is also a U-shaped relationship between potential slack and financial profitability, showing the need to use these resources in their appropriate proportion. Excessive leverage or scarce use of external financing reflects situations that harm profitability, especially in the short term.

Finally, the duration of the effects of the slack on performance is only seen consistently in the case of recoverable slack, showing that inefficiency in the use of human resources is difficult to eliminate over time, although the effect decreases over the years. Available slack only has an impact in the short term, except in periods of economic prosperity that can continue for several years. The duration of the effect of potential slack is contingent on the stage of the cycle under consideration, with a more prolonged impact on periods of growth than crisis.

In conclusion, when analysing and determining the slack resources–performance relationship, it is necessary to take into account the type of slack, the measurement of performance and other contingent variables, such as the period and context in which this relationship is studied. Although the concept of slack is widely accepted, characterised by those resources that can be deployed quickly to support a series of actions to achieve organisational objectives (Sharfman *et al.*, 1988), its nature is complex, and, therefore, its relationship with performance offers diverse results.

Slack resources respond to the advice of saving resources for scarcity times. However, this strategic recommendation does not seem to be adequate for all slack resources. Only the available slack, as its name reflects, has a consistent and positive effect on performance, but only in the short term. In addition, this relationship is curvilinear, highlighting the need for proper management of this type of resource. In the other types of slack, there are also persistent effects on performance, but, in the case of the recoverable slack, with a negative sign that contradicts the benefits provided by these resources, and in the case of the potential slack, the sign of the relationship changes, depending on the economic context considered.

Consequently, these results present important implications for academia and for practitioners. Thus, researchers must take into account this diversity of results according to the type of slack considered and adequately define the research issue and the context of the study. Thus, the literature that has paid attention to this issue must be cautious in order to control the economic situation as well as the firm-level variables as they seem to behave in a contingent way. From a practical point of view, managers must be cautious when accumulating resources that can be used in adverse or unexpected situations. Especially in the case of the recoverable slack, the results indicate that it is difficult to “recover” this type of resource in times of difficulty and that an excess of human resources leads to lower performance in any circumstance. The other types of slack require an intentional and adequate management because these resources positively affect the performance only in certain circumstances and quantities. As the effect of slack resources diminishes over time, it is necessary for the company to properly manage not only their use, but also the possible accumulation where feasible.

This study is not without its limitations. Thus, the sample selection concentrates on manufacturing industries, omitting extractive or service sectors (Marlin and Geiger, 2015). The incorporation of new sectors, or data from different countries, would make it possible to know the differentiated and comparative effect in order to arrive at more generalisable results, albeit the focus in the Spanish economy was justified by the overreaction showed during the crisis period studied. The possibility of carrying out a study of panel data may help to confirm the stability of the relations, although it is true that this methodological

approach will not allow us to contextualise the results and understand their symmetry. Another limitation is that the empirical model does not include potential moderators of the slack–profitability relationship (Carnes *et al.*, 2019). It is also necessary to acknowledge that the paper treats firms in a rather “systemic” manner, without paying attention to the critical role of agency (e.g. managers, executives). Finally, although the availability of data for a long period of time has allowed carrying out a longitudinal study of slacks, it has not been possible to determine how companies use these resources before internal or external fluctuations and for strategic purposes.

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Impact of the perception of performance appraisal practices on individual innovative behavior

Impact of the perception of PA practices

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Received 24 January 2019
Revised 18 July 2019
23 November 2019
Accepted 6 December 2019

Abstract

Purpose – The purpose of this paper is to analyze the impact of employees' perception of performance appraisal (PA) practices on innovative behavior (IB). The authors also propose to analyze consistency, a dimension of Human Resource Management (HRM) system strength, as a moderating variable in the aforementioned relationship.

Design/methodology/approach – A quantitative study was conducted, using a sample of 166 employees carrying out highly qualified, intensive knowledge jobs in four industrial companies in the Valencian region of Spain. The hypotheses were tested by applying the Smart-PLS 3.2 software.

Findings – The findings confirmed that in a context of professional and qualified work, PA practices have a direct and positive effect on IB. However, the results obtained did not enable us to affirm that employee perceptions of the consistency of the HR system moderated the relationship between PA and IB.

Originality/value – The paper's originality lies in including the role of consistency, a dimension of HRM system strength, in the analyzed relationship. When employees believe that PA achieves the goals for which this practice was designed, and that this appraisal follows a clear strategic direction over time, they perceive that the assessment system is not arbitrary, i.e., that this HR practice is being applied consistently. Consequently, the present work shows the relevant role of the perception of consistent PA when the firm wants to encourage IB. This fact opens up the field to study how to define and implement control mechanisms that tell managers whether there is a fit between employees' perceptions and the intentionality of the HRP these managers have defined.

Keywords Performance appraisal, Innovative behaviour, HRM system strength

Paper type Research paper

Introduction

Innovation is a key element for organizational differentiation and success. In this sense, there is increasing interest in analyzing how to promote innovation in organizations and in studying the mechanisms or factors that lead to the development of innovation capacity. Several previous works have dealt with this issue at organizational level. However, we would like to highlight the recent research that has emerged at individual level (Bednall *et al.*, 2014; Escribá-Carda *et al.*, 2017; Kehoe and Wright, 2013; Shanker *et al.*, 2017; Shin *et al.*, 2017). Analysis from the individual standpoint focuses on employees, considering them to be a key element in the development of innovation capacity in organizations. In this regard, Tang *et al.* (2017, p. 1319) emphasized that “employee creativity contributes substantially to organizational innovation and competitive advantage.”

Likewise, the literature highlights the impact that HR policies and practices (HRP) can have on promoting employees' innovative behavior (IB) (De Leede and Looise, 2005; Dorenbosch *et al.*, 2005; Hayton, 2005). In fact, the number of studies analyzing the influence

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This research has received financial support from the Spanish Ministry of Economy and Competitiveness (Reference code: ECO2015-69316-R).



European Journal of Management
and Business Economics
Vol. 29 No. 3, 2020
pp. 277-296
Emerald Publishing Limited
e-ISSN: 2444-8494
p-ISSN: 2444-8451
DOI 10.1108/EJMBE-01-2019-0018

of these practices on creativity and individual IB has increased (Fu *et al.*, 2015). In this sense, the ability–motivation–opportunity (AMO) framework (Appelbaum *et al.*, 2000; Boxall and Purcell, 2003) has been widely used to explain the link between HRP and individual behavior (Andreeva and Sergeeva, 2016). However, as Tang *et al.* (2017, p. 1319) pointed out, together with (Ehnert *et al.*, 2016; Pfeffer, 2010; Shipton *et al.*, 2016), further studies are necessary “considering that sustainable organizational performance is hinged on organizational innovativeness and a highly skilled and committed workforce.”

However, the design and application of HRP is not sufficient to generate IB since employees may not perceive these practices correctly and, therefore, they may not achieve the expected effect (Nishii *et al.*, 2008). This argument can explain the inconclusive results obtained by previous works, and make it necessary to adopt another perspective in the analysis, as authors such as Boxall and MacKy (2009), Escribá-Carda *et al.* (2017) and Lepak *et al.* (2006) defend. It is necessary to introduce the perceptions of employees in the framework of analysis (Fu *et al.*, 2015; Takeuchi *et al.*, 2009) differentiating, in this way, between the intended, implemented and perceived HRP (Vermeeren, 2010; Nishii, 2013).

The concept of HR system strength, developed initially by Bowen and Ostroff (2004), is argued to be related to the perceptions that employees have of how HRP are implemented. According to Sanders *et al.* (2014), an HR system should be perceived as distinctive, consistent and able to create consensus (human resource management (HRM) system strength) among employees (Bowen and Ostroff, 2004) in order to favor the adoption of the expected attitudes and behaviors for the fulfillment of the organization’s objectives (Kelley, 1973). These three features have been defined as the core dimensions of the HR system strength concept. However, the literature has not established conclusive results about the effect that HRM system strength has on perceptions and consequently on individual behavior. Along these lines, we found works that pointed to a possible direct effect on behavior (Sanders *et al.*, 2008; Li *et al.*, 2011; Farndale and Sanders, 2017), whilst others highlighted a moderating effect of this variable (Pereira and Gomes, 2012; Bednall *et al.*, 2014; Dello Russo *et al.*, 2018; Waheed *et al.*, 2018), and other research posited a mediating effect (Ostroff and Bowen, 2016; Rabenu *et al.*, 2018; Tziner and Rabenu, 2018). Yet there are still other issues to be answered and as Sanders *et al.* (2014) pointed out, perhaps the impact of the three dimensions that make up HRM system strength (distinctiveness, consistency and consensus) should be analyzed from an individual and not joint perspective. This means studying how each of these dimensions influences employees’ perceptions and their behavior separately.

Therefore, in the light of the gaps found and the arguments set out above, this paper analyzes the influence of one of these HR practices on IB. We have studied the impact of performance appraisal (PA) because is considered to be one of the most important HR practices for several reasons. First, it is highly relevant when it comes to explaining differences in organizational performance (Shipton *et al.*, 2005; Bednall *et al.*, 2014); second, it creates a link between individual performance and strategic organizational goals (DeNisi and Sonesh, 2010; Bednall *et al.*, 2014; Andreeva *et al.*, 2017); and finally, through this practice, expectations and goals for subordinates are defined, communicated, reviewed and evaluated by comparing it with pre-established standards (Kampkotter, 2015; Warokka *et al.*, 2012; Dessler and Varkkey, 2016). We have also focused on the possible moderating effect that one of the dimensions of HRM strength can have on this relationship. We are aware of the fact that targeting one of the dimensions may lead to the inconclusive results obtained in previous works on the impact of HRM strength on individual perceptions and behaviors. The dimension at the core of our analysis is consistency. The rationale for focusing on this dimension is because we consider that consistency may play a key role in the relationship studied, as it shows the degree of coherence between the messages sent by HR managers and the implemented practices, in relation to the organizational goals. As stated by Pereira and Gomes (2012), consistency helps

employees to know what the firm expects of them. This implies that consistency facilitates the stability of the signals given out so that employees can perceive clear cause-and-effect relationships in the designed HR practices, in the behaviors expected from employees and the related consequences. This can mitigate the implementation and interpretation gaps in HR practices. In addition, in our case, we consider that it can strengthen the relationship between PA and the desired IB. Therefore, we analyze whether individual behaviors will be more oriented to organizational goals (IB) if PA is perceived as consistent.

The results of this research can be used by managers as a set of guidelines to improve the design, communication and implementation of PA practices. In particular, this research shows the relevance of the design of PA systems in order to improve innovative employee behavior. It also shows the need for an adequate communication process, providing information about the expected goals and the results of PA. In addition, it shows whether the consistency of the process is a key factor in obtaining the desired employee behavior.

Theoretical background

Performance appraisal and innovative behavior

From the review of the traditional literature on HRM, there is no doubt about the impact of HRP on organizational performance. These practices establish the conditions in which relationships between employees and the organization are developed, and they can favor or hinder the employees from adopting positive attitudes and behavior toward the achievement of the organization's goals (Ling and Nasurdin, 2010).

In the last decade, some works have emphasized the role of HR practices in the maximization of individual performance and commitment, and particularly in the promotion of IB (De Leede and Looise, 2005; Dorenbosch *et al.*, 2005; Hayton, 2005). IB is defined as "the ability of individuals to generate new ideas and viewpoints which are subsequently transformed into innovation" (Escribá-Carda *et al.*, 2017, p. 273). We argue that the process of generating innovation lies in the creation of new ideas and in how individuals develop them; it is the knowledge accumulated and shared by individuals that increases the possibility of generating a behavior more oriented to innovation (Escribá-Carda *et al.*, 2017).

Based on the approach proposed by Bowen and Ostroff (2004), and in terms of HRM content, in the present work we focus on PA as a possible antecedent of the IB of employees. PA is considered to be one of the most important HR practices to the extent that it creates a link between organizational performance and the objectives of the organization (DeNisi and Sonesh, 2010; Bednall *et al.*, 2014; Andreeva *et al.*, 2017). In addition, it explains differences in organizational performance (Gupta and Singhal, 1993; Jiménez-Jiménez and Sanz-Valle, 2005; Shipton *et al.*, 2005; Bednall *et al.*, 2014). According to Andreeva *et al.* (2017), this is possible because through PA, expectations are stated, certain behaviors are encouraged and feedback is provided. In short, and as pointed out by Ahmed and Sattar (2018, p. 87) based on Dusterhoff *et al.* (2014), PA is considered as "a key component of strategic approach to management in that it is instrumental in linking competencies and behaviour of an employee with strategic objectives of an organization."

However, despite being considered key to explaining individual behaviors, it is perhaps one of the least studied HR practices in relation to its impact on the adoption of knowledge behavior and by extension, IB (Andreeva *et al.*, 2017). In addition, the scarce evidence found in the literature yields inconclusive results as to whether this relationship is positive or negative (Shipton *et al.*, 2006; Jiang *et al.*, 2012; Medcof and Song, 2013; Bednall *et al.*, 2014; Rabenu *et al.*, 2018).

PA is defined as a formal and planned process by which managers obtain accurate and reliable information on the behavior and performance of employees in their job (Rabenu *et al.*, 2018). Thus, it implies both the identification of performance dimensions and the measurement of employees' performance; and, in a second stage, performance management

(Gómez-Mejía *et al.*, 2007). Although identifying the dimensions that determine efficient performance will enable the application of different methods to measure the performance achieved by each employee, nothing would make sense without performance management. The management of PA results is the main objective of this HR practice. It should be oriented toward the future giving feedback that provides useful information to employees not only to correct mistakes and learn, but also to create an environment that facilitates the sharing of information among the members of the organization, which is a key aspect to foster innovation (Bednall *et al.*, 2014).

Accordingly, PA can have both administrative and development purposes and, by extension, affects individual behavior such as IB. From an administrative standpoint, appraisals constitute the basis of the decisions made on working conditions, promotions, dismissals and rewards, among others. Hence, based on the AMO framework, PA can affect both intrinsic (e.g. working conditions) and extrinsic motivation (e.g. rewards) and consequently, IB. Andreeva and Sergeeva (2016) stated that the effect of HRP on individual performance does not occur directly, but instead takes place through motivation at individual level. Thus, the individual motivation to perform work becomes an important mechanism through which HRP influence the level of knowledge exchange of employees. This exchange facilitates the exploration and identification of new ideas and opportunities and, consequently, the adoption of IB.

However, the purpose of PA can also be employee development. In this case, this practice focuses on improving and developing employees' abilities once their weaknesses and the possible causes of these have been detected. That is why, through correct communication of PA results, the organization can provide feedback and advice on effective work behaviors or can design specific training plans. In addition, it can promote the development of employees' potential and, consequently, generate in them the feeling of being more competent and, therefore, more able to contribute with new ideas and new ways of doing things in the organization.

Bednall *et al.* (2014) pointed out that PA can be a very useful tool from an individual perspective if the people in charge of it provide employees with the appropriate feedback. It can help employees to manage and see errors as a learning opportunity, and to share knowledge and generate new ideas without the fear of being penalized if the desired results are not obtained. The authors suggest that the perception of adequate PA will facilitate knowledge-sharing and IB.

In short, although it is true to say that in some organizations PA may be linked to a reward system, its main purpose is to act in two key areas: first, to give employees a clearer vision about what is expected of them and consequently about the strategic objectives of the company to which individual goals must be aligned; and second, as we have indicated in the previous paragraph, to highlight the importance of receiving adequate feedback on their performance and their job-related behaviors (Rabenu *et al.*, 2018, p. 207).

Based on the social exchange theory, PA, through the feedback it provides, can explain and predict knowledge-sharing and, with this, foster individual IB (Aktharsha and Sengottuvel, 2016). Thus, Radaelli *et al.* (2014) emphasized that organizations which stimulate knowledge-sharing inside and outside their limits are more likely to develop innovation and, consequently, obtain better performance. Social interactions are regulated by norms of reciprocity (Blau, 1964). Thus, when employees receive feedback through a PA, they will feel obliged to return "the favor," adopting positive attitudes and behaviors toward the organization, such as providing new information and ideas that facilitate innovation (Radaelli *et al.*, 2014). Additionally, Chen and Huang (2009) and Jaw and Liu (2003) argued that the pressure that employees feel when they know that are going to be the subject of a PA process, can be positive. This pressure leads them to take on new challenges and tasks, guiding and promoting IB. They affirmed that PA, together with other practices, contributes to increase innovation results in the organization.

Ismail and Rishani (2018) pointed out an expected reciprocity in the organization–employee relationship. Thus, if the employee perceives that they can receive useful feedback from the PA, they also feel obliged to return something to the organization, in the form of new ideas or creative behavior. In addition, the impact of PA on knowledge-sharing and, as a consequence, on the adoption of IBs by employees increases if the aspects evaluated include knowledge activities (knowledge-sharing, creation and utilization) (Inkinen *et al.*, 2015). Receiving feedback at this level can improve IB. In this respect, Jiménez-Jiménez and Sanz-Valle (2005) stated that there is a direct relationship between the adoption of an innovation strategy by the organization and the application of PA practices, both focused on development and results. However, this work analyzed the relationship at organizational level.

Conversely, the success of the PA will depend not only on how the feedback is provided, that is, whether or not it facilitates dialogue that provides opportunities for improvement, but also on the quality of the PA experience (Brown *et al.*, 2010; Bednall *et al.*, 2014; Ismail and Rishani, 2018). In this respect, Sharma and Sharma (2017, p. 685) pointed out that the PA system is of critical importance given that, in many situations, employee dissatisfaction is explained because they perceive the system as being unfair and ineffective (Shrivastava and Purang, 2011). This fact “can further be linked to negative employee outcomes such as higher turnover intention and lower commitment levels (Dusterhoff *et al.*, 2014), which subsequently negatively affects employee performance” (Sharma and Sharma, 2017, p. 685).

Employees’ perception of the PA will influence the level of commitment toward achieving organizational goals and, ultimately, the behaviors of sharing information and innovation (Aktharsha and Sengottuvel, 2016). If employees feel satisfied with the PA, they will be encouraged and motivated to adopt positive behaviors, such as developing and implementing innovative ideas in their organization (Niu, 2014). They will feel obliged to repay the firm through enhanced behavior such as creative contributions (Ismail and Rishani, 2018).

From the previous arguments, we can formulate our first hypothesis:

H1. PA practices will favor IB in employees.

The concept of HRM system strength

HRP constitute a key factor for organizational competitive advantage (Becker and Huselid, 1998). HRP guide and influence individual behavior to ensure that employees are sufficiently motivated to work toward achieving organizational objectives.

Thus, PA is one of the key HRP to achieve expected individual behavior (Bednall *et al.*, 2014), such as IB, as we have hypothesized in the previous section.

Some authors argue that PA may not always generate the desired effects on individual behavior, due to the existence of asymmetry problems between the appraised subject and the appraiser (Azzone and Palermo, 2011; Fay and Thompson, 2001). This fact shows that the design and application of specific HRP, such as PAs, is not enough to generate the desired behaviors, since these practices may not be perceived correctly by the employees or the employees may think that they are not going to contribute to the achievement of the desired goals (Nishii *et al.*, 2008). This makes employees, and more specifically, their perceptions, a key factor to consider (Sanders *et al.*, 2008).

Under these conditions, it is essential to focus any analysis on the role played by process aspects linked to the implementation of HRP (Bowen and Ostroff, 2004).

The HRM process refers to whether employees have the ability to understand the signals and messages sent by the organization and to respond accordingly in the manner expected by the latter (Escribá-Carda, 2015). Delmotte *et al.* (2012, p. 1481) defined it as “the set of activities aimed at developing, communicating, and implementing HR practices.”

Khilji and Wang (2006) concluded that there is a clear distinction between what is intentionally defined by managers, in terms of HRP, and what is actually experienced or perceived by employees.

This approach focuses attention, on one hand, on the importance of the psychological processes through which employees interpret and respond to the information contained in the HR system (Bowen and Ostroff, 2004; Ehrnrooth and Björkman, 2012; Escribá-Carda, 2015); and on the other, on the design and effective administration of the HRM system (Bowen and Ostroff, 2004). If we put the focus on the “process” aspects, the concept of HRM strength emerges, which refers to the effectiveness of sending the appropriate signals to employees in relation to the type of conduct expected and measured by managers and organization (Bednall *et al.*, 2014; Bowen and Ostroff, 2004).

Consequently, following Bowen and Ostroff (2004) and Garcia-Carbonell *et al.* (2015), HRM system strength is defined by three dimensions: distinctiveness; consistency and consensus. Distinctiveness refers to the degree of visibility, clarity and certainty of the HRM system for all members of the organization and measures whether the system captures employees’ attention (Bednall *et al.*, 2014). Bowen and Ostroff (2004) included four attributes to define this dimension: visibility, understanding, legitimacy of authority and relevance.

Visibility refers to the degree to which the HRP are easily observable, which may favor the interpretation of information and, therefore, the construction of cause-and-effect relationships in the minds of employees (García *et al.*, 2013; Garcia-Carbonell *et al.*, 2015). In addition, practices must be understandable, as this will foster a shared interpretation. Conversely, if the content of the practices is ambiguous, there will be a high risk of misunderstanding, that is, employees will understand the implemented practices in a different way with respect to the original intentions of managers. Legitimacy of authority is related to the degree to which employees consider that the HR function has a high status and credibility. The CEO should send signals showing the strategic value of the HR function in the organization. The last attribute of this dimension is relevance, that is, the degree to which individuals perceive HRP as being important to achieve strategic objectives. According to García *et al.* (2013), through these four attributes, the distinctiveness dimension essentially reflects the perceived importance of the HR function. Bowen and Ostroff (2004) highlighted the importance of these four attributes as they focus on the message and on the communicator, which increases the likelihood of adequate and uniform coding and interpretation of the HRM message.

Another dimension refers to consensus, which is related to the degree of agreement among employees in their perception of cause-and-effect relationships. This dimension refers to the probability of employees behaving in a similar way when sharing perceptions. As in the rest of the dimensions, we find two aspects that help to better analyze this dimension, which are: agreement between the main agents that must make HRM decisions and justice or equity.

Agreement between the main agents that must make HR decisions: this sub-dimension refers to the good collaboration among top management team (TMT) and HR managers, who should be integrated in this TMT and jointly define and implement the HR strategy of the firm (Bowen and Ostroff, 2004). This facilitates easier identification of the relevant HR strategic objectives and it is a way of recognizing the authority of the persons in charge of HRP (García *et al.*, 2013), that will be perceived as a key player in the strategy-making process.

Equity is the cornerstone of any HR system: the perception of equity directly affects employees’ behavior, as they notice that when they perform better, they receive a fair compensation. Equity enhances the worker’s assimilation of the functioning of the system and the rationality of the evaluation results with respect to the methods used (García *et al.*, 2013). A lack of equity in the HRM system will generate dissatisfaction among employees, which can negatively affect the individual behaviors and organizational results.

Finally, consistency refers to the degree to which HRP communicate consistent and regular messages over time, to people and in context. It is related to the degree to which the messages emanating from HRP are uniformly coded and interpreted by employees. Bowen and Ostroff (2004) associated three attributes with this dimension: instrumentality, validity and the consistency or coherence of the information that the HRM system transmits.

Instrumentality refers to the degree to which employees perceive the cause-and-effect relationship, that is, the relationship between the content of HRP and the consequences/behaviors expected from these practices.

Validity is related to the degree to which the employees perceive the HRP messages as being valid. This attribute reflects the “degree to which employees perceive that the HRM system is properly designed and will produce the expected effects” (García-Carbonell *et al.*, 2014, p. 142). Therefore, HR practices show consistency when their implementation (and their perception by the employees) do or achieve what they strategically intend to do (Delmotte *et al.*, 2012).

Coherence of HRP refers to the degree of compatibility and stability in the signals associated with HRP. A lack of consistency could lead to different interpretations of HRP or the reception of contradictory messages (Kepes and Delery, 2007). This fact could generate confusion among employees. Therefore, the information coming from senior management, in relation to the organizational objectives and/or values, must be consistent with that interpreted by employees, based on their perceptions (García *et al.*, 2013).

Consequently, a consistent HRM system implies the stability of signals over a long period of time, so that employees can clearly perceive cause-and-effect relationships between practices, desired behaviors and associated consequences.

Most authors suggest that the goal of HR managers is to create a common context and coherent practices for employees (Ostroff and Bowen, 2016), leading to understanding and acceptance of the HRP implemented and unequivocal understanding of the expected behaviors (Bednall *et al.*, 2014). Following the arguments of Dello Russo *et al.* (2018), HRP are effective when they are consistently applied in the organization, because employees perceive and interpret them in the same way. From the other features that make up the HR strength concept, these authors point to consistency as the most relevant variable, when they state that variability in employees’ perceptions “indicates that the HR message is most likely ambiguous because it does not uniformly reach all employees” (Dello Russo *et al.*, 2018, p. 291).

Although some authors analyze the concept of HRM strength as a whole, others do so based on one or two of its dimensions, depending on the relationship analyzed. The works of Bednall *et al.* (2014), García *et al.* (2013) and Pereira and Gomes (2012) analyzed the concept as a whole. For example, García *et al.* (2013) stated that if employees perceive a fully integrated HRM system, and the standards and attitudes required are well-known, this perception of integration will lead them to align their actions with the objectives of the organization. Conversely, an ambiguous situation is generated when employees perceive the messages of HR managers in a different way and there is no common understanding of HR managers’ intentions. The work of Dorenbosch *et al.* (2006) only focused on two sub-dimensions: consensus in the HR message and legitimacy of the HR message. They decided to examine only these two features of strength because they are the sub-dimensions that directly affect the relationship studied between line managers and HR professionals.

Following this line of research, we decided to focus on one strength dimension, namely consistency, which may play a key role in the relationship between PA and IB. Consistency shows the coherence between the messages sent by HR managers and the practices they implement in relation to the definition of organizational objectives and/or values. Consistency “helps employees to gain awareness and understand what is expected of them” (Pereira and Gomes, 2012, p. 4303). Accordingly, one of the main objectives of PA is to transmit to employees what the organization expects from them. If this HR practice is perceived as consistent, individual behaviors will be more oriented toward organizational goals.

Moreover, consistency establishes the perception of a cause-and-effect relationship (Pereira and Gomes, 2012), that is, when the employee knows exactly (in our case, through the PA objectives) what the desired behavior and its associated consequences are, they are more likely to invest all their efforts in achieving these results and expected behavior.

The moderating effect of the perception of consistency in the relationship between performance appraisal and innovative behavior

As mentioned previously, authors such as Dusterhoff *et al.* (2014) and Ahmed and Sattar (2018, p. 87) assign a strategic role to PA, as it is essential to link employees' behavior and skills with an organization's strategic objectives. Accordingly, as the organization's objectives are oriented toward innovation, the PA system should be designed so that it enables employees to cultivate this type of behavior (IB).

In turn, the efficiency of an HRP system, measured in terms of motivation or of encouraging certain employee attitudes and/or behaviors, will be conditioned by the perceptions that these employees have of them (Gibb, 2001; García-Carbonell *et al.*, 2014, p. 140). Accordingly, if employees perceive that their organization believes them to be key or strategic, "they will respond with positive behavior oriented to achieving the organization's objectives" (García-Carbonell *et al.*, 2014, p. 140).

The study of the influence of HR system strength on the relationship between HRP and results (in terms of commitment, organizational climate, IB and organizational performance) has been addressed from different methodological approaches. Some studies have analyzed the moderating effect of HR system strength (Dello Russo *et al.*, 2018; Bednall *et al.*, 2014; Pereira and Gomes, 2012), that is, the authors have tried to analyze whether the existence of a strong perception of the HR management system intensifies the previous relationship between HRP and results. In their investigation, Chen *et al.* (2007, p. 1134) found that the strength of the HRP system played a moderating role in the relationship between HRP and employees' commitment, i.e., "the more consistent the perception of HR practices between managers and employees, the greater the employee commitment, suggesting that HR systems and practices communicate clear and direct signals to employees regarding norms and expectations."

Conversely, others consider that strength plays the role of a mediator between HRP and performance measures (Ostroff and Bowen, 2016; Rabenu *et al.*, 2018). In fact, this last paper examines whether HR strength is a mediator or a moderator in the HRP–innovation relationship, considering four high-commitment HRP individually: training and education, career management, decision making and PA. Their results show that strength is a full mediator in the relationship between PA and organizational innovation (Rabenu *et al.*, 2018; Tziner and Rabenu, 2018).

Bowen and Ostroff (2004) also established the main features of the concept, arguing that strength acts as a mediator in the relationship between HRM practices and performance. They posited that the relationship between HRM systems and performance is mediated by psychological strength. Later on, in their review paper about the reflections on the construct, over a decade after their 2004 paper, these authors continued to argue that their framework aims to explain how HRM systems forge substantial linkages, in the shape of mediators, to explain the relationship between HR systems and performance (Ostroff and Bowen, 2016).

The above demonstrates that research into the influence of HR system strength on the relationship between HRP and their results does not offer conclusive evidence. This leads to the need to carry out further research in order to establish whether the effect of HRM system strength, or of any of its individual dimensions, on perceptions and the resulting behavior is a direct, mediating or moderating one. In the light of this gap, in this paper we have aimed to explore the moderating effect of the dimension under study (consistency), given that the analytical logic tells us that the greater the perceived consistency, the more employees will

feel that the practices are not biased or erratic, and therefore, the direct relationship between the designed PA system and the expected (innovative) behavior will be reinforced. We consider that consistency, as a dimension, can also be applied to each of the human resource practices and, in the case of this research, to PA. Just as it is argued that to ensure there is no mismatch between implementation and interpretation, the HRM system must be perceived as being consistent. In our view, PA practices must also be perceived as being consistent so that employees can behave as expected (IB).

For the particular case of the PA under study, employees can be expected to increase their satisfaction, and therefore, adopt the expected behaviors, in so far as they perceive the system as being appropriate, related and unbiased. Conversely, PA can cause great dissatisfaction when employees perceive that the process is incomplete, ambiguous, unfair, political and subjective (Skarlicki and Folger, 1997; Ahmed and Sattar, 2018, p. 97).

The consistency of the system is linked to the fact that the policies put into practice, in our case PA, are not erratic, nor do they have any unpredictable effects. In fact, quite the contrary is true: they need to be the result of deliberate strategic processes (García-Carbonell *et al.*, 2014, p. 142). More precisely, it is a question of ensuring that PA does not display any ambiguities in its cause-and-effect relationships, that is, the actions defined and put into practice must lead to the behaviors expected of employees. Likewise, the PA system must be consistent in the sense that “related practices must be understood in a uniform manner by all employees, given that they are capable of sending out coherent messages, thus fostering agreement among workers (Nishii *et al.*, 2008)” (García-Carbonell *et al.*, 2014, p. 142).

On the other hand, if the system is not consistent, employees may receive conflicting information about the same PA practice, leading to confusion among the workforce as to what PA aims to achieve. As Delmotte *et al.* (2012) and García-Carbonell *et al.* (2014, p. 142) pointed out: “the confusion generated by the lack of consistency would prevent the creation of shared meanings required for the implementation of joint responses aimed at achieving business success.”

Consequently, we can establish that the consistency of PA, in terms of what is intended to be achieved and what is actually achieved, will help to create a solid and shared situation among the members of the organization that will coincide with managers’ intentions. When employees perceive that PA is consistent, the shared vision of the members of the organization will be reinforced and behavior will be aligned with the vision and objectives of the organization (García-Carbonell *et al.*, 2014, p. 140). Accordingly, employees will feel that the appraisal helps them to improve and achieve their objectives, and they will try harder to achieve their goals, orientating their behavior toward what the organization expects from them and intensifying the direct effect of PA on IB.

In short, we propose that the dimension of consistency has a moderating effect on the relationship between PA and IB; that is, if PA is perceived as consistent, the relationship between PA and IB will be stronger.

According to these arguments, we formulated our second hypothesis:

H2. Consistency moderates the relationship between PA and employees’ IB.

Methodology

Procedure and sample

Our sample consisted of 166 employees carrying out intensive knowledge jobs in four industrial companies in the Valencian region of Spain.

These employees belonged to different departments: marketing, purchasing, human resources, information technology, research and development. We selected this type of employees as they worked in organizations that compete with innovative products and/or advanced manufacturing technologies. In addition, they belonged to departments where

knowledge and learning are key factors for them to perform their work. The companies in the study had a special interest in analyzing the extent to which their employees' perceptions of applied HRP, specifically in terms of PA, affected the relationship of these practices on IB.

Measurement procedures

The different constructs analyzed were measured using multiple item scales (seven-point Likert scales) based on previous studies. A pretest of the questionnaire was carried out with some skilled employees included in the sample. The information obtained enabled us to refine the tool.

The final version of the survey was sent by e-mail to employees, who had to respond through a link. In other cases, the questionnaires were completed in the workplace, filling them out voluntarily and collecting them through a suggestion box.

The data were collected in 2018. Regarding the gender variable, 51.3 percent were men and 48.7 percent were women. With respect to experience in the sector, the results indicate that most of the employees had been working in their industry for a prolonged period of time (average accumulated experience of 13.6 years). Only 25 percent of the sample had been working in their sector for less than five years.

Measurement scales

The PA scale (two items) was taken from the work of Jensen *et al.* (2013). The scale that measured individual IB had six items and was drawn up by Scott and Bruce (1994). The scale that measured the consistency of the HRP system included a dimension of the scale developed by Bednall *et al.* (2014).

Data analysis

Smart-PLS 3.2 (Ringle *et al.*, 2015) was used to test the hypotheses proposed in our model. Bootstrapping was used to generate standard errors and *t*-statistics. We proposed two relationships or hypotheses:

- (1) *H1* aimed to measure the direct effect of PA on IB; and
- (2) *H2* measured the moderating effect of consistency on the relationship between PA and IB.

Analysis and results

Descriptive analysis

Table I shows the means, standard deviations and correlations of the different constructs analyzed and the control variables included. The correlations between PA, IB and the consistency of the HRP were positive and significant ($p < 0.01$).

	Mean	SD	1	2	3	4
1. Performance appraisal	4.68	1.57				
2. Innovative behavior	4.97	1.1	0.383**			
3. HRP Consistency	4.67	1.3	0.702**	0.452**		
4. Gender	0.49	0.50	-0.041	-0.156	-0.215*	
5. Experience	13.59	9.65	0.083	-0.103	0.208*	-0.168*

Notes: * $p < 0.05$; ** $p < 0.01$

Table I.
Means, standard deviations and correlations between study variables

Evaluation of the structural model

To estimate the structural model, we used partial least squares path modeling (PLSPM) using Smart-PLS 3.2. Our study used reflexive constructions.

The properties of the measurement model were evaluated according to the recommendations of Hair *et al.* (2012) for PLSPM. All the indicators were significantly associated with their respective constructs ($p < 0.01$) with standardized loads greater than 0.7 (Barroso *et al.*, 2010). These results show a high reliability of the indicator.

Table II shows the internal consistency, and convergent and discriminant validity. We used the measures of composite reliability (CR) and average variance extracted (AVE) to evaluate internal consistency and convergent validity. The CR values of the constructs varied from 0.91 to 0.95, and were all greater than the threshold of 0.7 (Bagozzi and Yi, 1988). Similarly, the values of AVE for each construct were higher than the threshold of 0.50 (Fornell and Larcker, 1981), confirming the convergent validity of the measurement model.

Finally, to test discriminant validity we used the measure proposed by Henseler *et al.* (2015), i.e., the heterotrait-monotrait (HTMT) ratio of the correlations (Voorhees *et al.*, 2016). There are discriminant validity issues when HTMT values are high, with Henseler *et al.* (2015) proposing a threshold value of 0.90. As we can see in Table II, the HTMT values were lower than the threshold.

Structural model

The predictive relevance of the two dependent variables on the model was evaluated using Stone-Geisser's Q^2 (Geisser, 1975; Stone, 1974), measured using blindfolding procedures. All latent dependent variables exhibited a Q^2 greater than 0 ($Q^2(\text{IB}) = 0.16$; $Q^2(\text{Consistency}) = 0.36$), suggesting the predictive relevance of the model (Chin, 1998). The R^2 value of the latent dependent variables was used to determine the amount of variance explained by the model (see Tables III and IV). According to Falck and Miller (1992), this index must be greater than 0.1.

Testing hypotheses

H1 focused on the direct effect of PA on IB. The analysis results show a positive and significant effect on IB ($r = 0.40$, $p < 0.00$, $t = 5.82$). Therefore, our first hypothesis is supported.

	CR	AVE	1	2
1. Performance appraisal	0.91	0.84		
2. Innovative behavior	0.93	0.69	<i>0.45</i>	
3. HRP consistency	0.95	0.76	<i>0.80</i>	<i>0.50</i>

Note: Italic values are HT-MT ratios

Table II.
Internal consistency, convergent and discriminant validity

Proposed relationships	Estimate	<i>t</i> -value	Result
Direct effect of performance appraisal on IB	0.40***	5.82	<i>H1</i> accepted
<i>Moderation test</i>			
Effect of consistency on IB	0.38***	3.86	
Moderating effect of consistency	-0.09	0.59	<i>H2</i> rejected

Notes: $R^2(\text{IB}) = 0.25$. The experience control variables show a significant influence on IB. *** $p < 0.01$

Table III.
Testing hypotheses

The second hypothesis predicted a moderating effect of consistency in the relationship between PA and IB. Results showed that consistency was positively and significantly linked to IB ($r = 0.38; p < 0.00$; value $t = 3.86$). However, the moderating effect was not significant ($r = -0.09; p > 0.05$; value $t = 0.59$). Thus, we cannot confirm $H2$ (Figure 1).

Otherwise, following the previous literature (Ostroff and Bowen, 2016; Rabenu *et al.*, 2018; Tziner and Rabenu, 2018) that predicted or tested the mediation hypothesis, we have tried to analyze whether consistency had any kind of mediating effect between the two variables analyzed (PA and IB). The alternative mediating hypothesis proposed an indirect effect of PA on IB through the perceived consistency of this HR practice, that is, the mediating effect of consistency in the previous relationship. As shown in Table IV, the indirect effect was significant ($r = 0.28, p < 0.00$, value $t = 2.84$). Besides, the confidence interval bias corrected did not include 0 (0.078–0.448). The table also shows that the direct relationship was not significant.

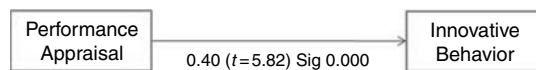
Therefore, we can affirm that consistency mediated the relationship between PA and IB. Therefore, PA influenced IB when employees perceived that the practices served the purposes for which they were designed, remained constant over time and helped to consolidate the shared vision of the organization's members. That is to say, the effect of PA on IB takes place through the perception of the consistency of this practice (PA) implemented by the organization.

Proposed relationships	Estimate	t-value	2.5%	97.5%
Direct effect of performance appraisal on IB	0.13	0.986		
Indirect effect of performance appraisal on IB through the consistency	0.28***	2.837		
Confidence intervals bias corrected of the indirect effect			0.078	0.45

Table IV.
Testing the mediation hypothesis

Notes: R^2 (IB) = 0.24; R^2 (consistency) = 0.52. The experience control variables show a significant influence on IB. *** $p < 0.01$

H1: Direct relationship



H2: Moderation

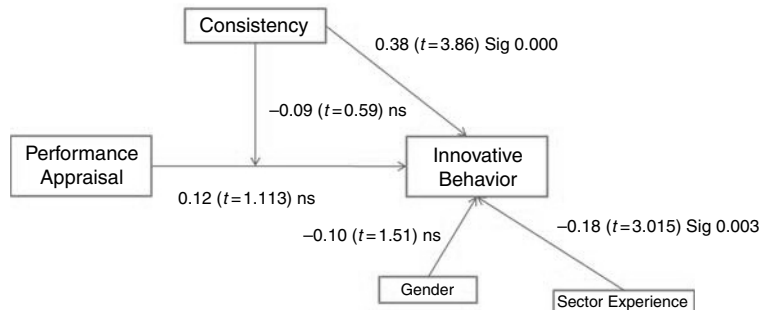


Figure 1.
Direct relationship and moderation effect

In addition, as we can see in the note in Table IV, only one of the control variables (experience in the sector) had a significant influence on IB. In particular, employees' experience showed a negative effect on IB.

These results are shown in Figure 2.

Discussion and conclusions

This research tries to address a topic that has not received sufficient attention in the literature. In particular, we focused on the effect of consistency (as a dimension of HRM system strength) on the relationship between PA and employees' IB. As argued in the theoretical framework, there is general agreement in pointing out the role played by PA in achieving organizational goals. It can be stated that fostering IB among employees is today one of the key aspects in improving organizational competitiveness.

Although it is not possible to categorically state that IB is difficult to encourage in any type of work, from our point of view, it is more likely to occur in more qualified and complex jobs. In general, there are many exceptionalities and changes in a qualified and complex job which force employees to seek solutions to the different contingencies that may occur. This dynamic nature can develop an ability to generate new ideas and points of view that can be transformed into innovation. Faced with this type of qualified and complex jobs, high performance and commitment practices make total sense, since management will use them to achieve IB.

However, previous works have stated that the design and application of HRP is not sufficient to generate certain behaviors, such as IB, since these HRP may not be perceived correctly by employees and, therefore, may not have the desired effect on them (Bowen and Ostroff, 2004; Nishii *et al.*, 2008). Thus, it is interesting to ascertain how to achieve coincidence between the intentions of the management team, in terms of HRP, and what employees actually experience and perceive in relation to those practices. This interest corresponds to the theoretical trend that seeks to focus on process aspects, rather than on the content of HR practices themselves. Bowen and Ostroff (2004) initiated this process perspective when they talked about HRM system strength, a construct in which they identified three dimensions (distinctiveness, consensus and consistency). If employees perceive HRM as being fully integrated, their behavior will be aligned with the organization's objectives.

We consider that consistency, out of all of the HRM system strength dimensions, is the one that is most closely related to PA and IB. Consistency reflects the instrumental nature of the system, its validity and the coherence of the information transmitted by HRM; that is, the perception that the practices implemented are not erratic, nor are their effects unpredictable,

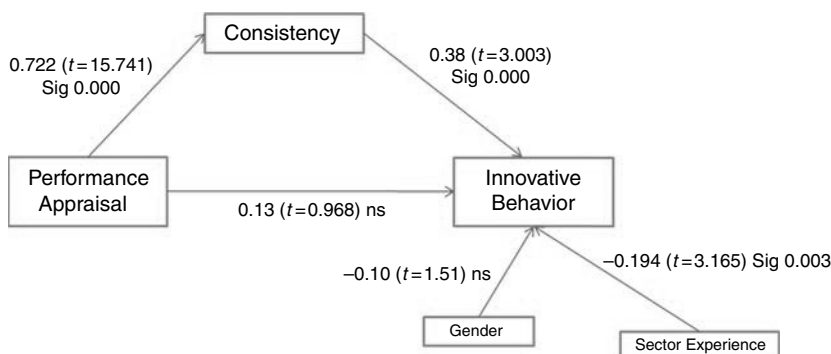


Figure 2. Mediation effect

but instead they respond to a previously designed and deliberate plan (García *et al.*, 2013). PA, which is related to the reward system, is one of the managerial practices that have the greatest influence in achieving desired behaviors. However, if we consider the process perspective, the system needs to be perceived as being consistent. It is only in this scenario that PA will lead to intentionally defined or expected behaviors. In this sense, we have formulated our hypotheses, establishing a direct relationship between PA and IB in a knowledge-intensive context; as well as establishing the moderating effect of the perception of consistency in this context. The first hypothesis, clearly relating PA to IB, was supported. However, we did not find a moderating or intensifying effect for consistency.

With respect to the first hypothesis, we can affirm that in a context of professional or qualified work, PA practices have a direct and positive effect on IB. We must not forget that PA is one of the practices that can have the greatest impact on the attitudes and behavior of employees, since it directly affects their work life, through the administration of rewards, including opportunities for compensation, promotion and training (Ismail and Rishani, 2018). All these practices (giving feedback to employees or establishing compensations related to PA), when properly managed, can stimulate and encourage IB.

However, the results on the moderating role of consistency were not significant. As we have argued in the theoretical framework, there is no clear approach when studying the role of the different dimensions of HRM strength on the analyzed behaviors. Consequently, we have also explored the mediating role of consistency, in line with the previous literature (Bowen and Ostroff, 2004; Ostroff and Bowen, 2016). Our results show the mediating effect of this particular dimension, consistency, on the relationship between PA and IB. That is, when firms work in a knowledge-intensive context, PA must be oriented to improving the capabilities of these knowledge workers, showing them their weaknesses so they can improve and continuously learn. This evaluation must offer them an opportunity to grow and develop inside the organization. However, if this appraisal is erratic (e.g. it is not consistent over time, is carried out randomly or everyone receives the same appraisal results), employees will feel that the objective of the assessment has not been achieved. Accordingly, a PA system oriented to learning and continuous improvement will be directly enhanced by the degree of consistency perceived by knowledge workers; and it is this perception of consistency which will lead employees to behave innovatively.

The results obtained can motivate future research focused on the link between the implementation of HRP and IB. In the case of employees with knowledge-intensive jobs, HRM must build an integrated and coherent system so the employees perceive it in the same way. This fact opens up the field to study how to define and implement control mechanisms that enable managers to ascertain whether there is a fit between employee perceptions and the intentionality of the HRP defined by managers. This research could provide authors interested in this topic with a starting point for further investigation into the subject. With the same underlying intention, some researchers may be interested in the study of communication processes analyzing the key elements that ensure there is no gap between managerial intentions and employee perceptions.

As a general recommendation, managers should not only pay attention to the content of practices in order to achieve organizational objectives, but should also focus on HR implementation aspects. This shift in the focus of attention will ensure that as long as employees perceive coherence, integrity and credibility in a firm's HRP, organizational objectives will be aligned with their own goals and, therefore, their behaviors will be geared to the achievement of these organizational goals. For practitioners, organizations that aim to encourage IB in their employees should firstly focus on the design of PA systems that include aspects related to knowledge activities. Therefore, when an

employee knows that they are going to be evaluated on these topics, they will direct their efforts to achieve these innovation results. In addition, if the employee receives feedback on these knowledge aspects, this will improve their IB. Second, the results of our research can help managers to focus on organizational aspects such as communication and feedback systems that can explain the successful implementation of HRP, and especially of PA. On one hand, managers have the responsibility of communicating the goals and expected behaviors to their employees and, on the other, they have to provide accurate and effective feedback of the results of the PA process. If employees clearly perceive what is expected of them and what they have to do to improve their behavior, that is, if the messages are consistent, innovation results will improve. Lastly, practitioners have to take into account the role of middle managers in the communication process. Middle managers also have to perceive consistent, unambiguous messages from the HR department as this will help them to clarify and efficiently transmit the goals and results of the PA process.

The research presented here is not free from limitations, but it can lay the foundations for future investigation. Our sample was made up of employees from industrial companies located in a particular area of Spain. Thus, in the future, it would be interesting to extend the sample to employees from different geographical areas, both inside and outside Spain. It would also be interesting to incorporate employees with knowledge-intensive jobs from companies working in the service sector in order to analyze whether this fact would generate different results.

Another limitation that we should highlight is the fact of having centered our analysis on employee perceptions. It would be interesting in future research to consider a multilevel perspective to compare the views of managers and employees. Last, but not least, it would be interesting to extend the study to test the effect of the other dimensions included in HRM system strength (consensus and distinction).

Finally, in this research we have focused on PA, system consistency and IB. In future research, it would be advisable to analyze the effect of other key human resource practices (e.g. professional development or participation in decision making) on IB.

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Causative effects of motivation to transfer learning among relational dyads: the test of a model

Causative
effects of
motivation

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Received 20 July 2019
Revised 20 December 2019
17 February 2020
Accepted 16 March 2020

Abstract

Purpose – The purpose of this study is to validate multiplicative cycle that exists between the job readiness and satisfaction model explored by Matthews *et al.* (2018), the satisfaction and performance paradigmatic nuances analyzed by Judge *et al.* (2001) and Gu and Chi (2009), in addition to the expectancy model theorized by Vroom (1964). The motivation to transfer learning serves as a conveyable variable transmitted within a learning continuum that sustains cyclical outputs.

Design/methodology/approach – An archetype to explore the connection between the three hypothesized theories is created through a neural network program. Exploring this connection develops deeper understandings of the derivatives of employee motivation as it pertains to its effect on readiness, satisfaction, performance and achievement dyads. A detailed analysis of the literature leads to the hypothesis that the motivation to transfer learning creates a multiplicative effect among hypothesized relationships.

Findings – The neural network program scaffolds the proposed general belief that positive effects of transfer motives cause a cyclical effect that continues to perpetuate among hypothesized dyads. Conversely, if this motivation decreases or ceases among one or more dyads, the cyclical effect will retract and, eventually stop.

Originality/value – Based on the neurologic outcome, one central theme emerged: managers must offer opportunities to acquire knowledge through assistive mechanisms (i.e. training) by providing external stability through controlled channels that activates the motivation to transfer learning into new opportunities. The transference of this knowledge produces reconstructive growth opportunities through continuous learning thus increasing performance.

Keywords Achievement, Readiness, Satisfaction, Performance, Motivation to transfer learning

Paper type Research paper

Introduction

Researchers have extensively studied instrumental modes of learning transference through intrinsic and extrinsic correlates (Deci and Ryan, 1985; Lepper *et al.*, 2005), organizational learning culture (Egan *et al.*, 2004), learner feedback (Islam, 2019). Noe (1986) defined the motivation to transfer learning as “the learner’s intended efforts to utilize skills and knowledge learned in training setting to a real-world work situation” (p. 743). Arguably, the impetus to transfer knowledge projects from the expectation that learners who convert training at work to explicit usefulness in pragmatic situations are more likely to be motivated. The successful application of newly acquired knowledge and skills elicits an attitudinal response associated with intrinsic precursors linked to self-determination theory (Baard *et al.*, 2004) and expectancy theory (Vroom, 1964). To map a culminating destination, Elliott and Murayama (2008) pronounced instrumental and terminal values aligned with dimensionality



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European Journal of Management
and Business Economics
Vol. 29 No. 3, 2020
pp. 297-314
Emerald Publishing Limited
e-ISSN: 2444-8494
p-ISSN: 2444-8451
DOI 10.1108/EJMBE-07-2019-0120

based on a mastery-performance construct. Distinctively, mastery focuses on actual learning, and performance focuses on the execution of what is learned. This lends itself to Noe and Schmitt's (1986) definition of motivation as an impulsion to utilize knowledge and skills mastered during a training program on a job.

Separate research has investigated and has proposed needs theories that accent a drive to exceed intrapersonal benchmarks and meet performance outcomes (Elliott and Murayama, 2008; Kumar and Jauhari, 2016; Maslow, 1954; McClelland, 1961; Stahl, 1986). The pursuit of achievement assigns a valence or attractiveness to obtain an outcome more efficiently and robust than historically performed. While this pursuit is marred by a possible avoidance of perceived effortless or laborious tasks, the need for achievement can be linked to fear of failure. Conceptually, the need to achieve presents an inherent factor that drives expectancy and instrumentality used to influence effort and performance calculation and perceived outcomes, thus increasing job satisfaction (Vroom, 1964). At the substratum of need-based theory, the measurement of intrinsic and extrinsic sources has postured opposing effects focused on a singular dimension (Harter, 1981) until Herzberg *et al.* (1959) compartmentalized job satisfaction and job dissatisfaction into motivational and informational components. An amalgam of both polar effects concurrently identifies behavioral outcomes that measure emotional, physical and cognitive engagement.

While the literature contains exhaustive studies on correlative relationships between readiness and satisfaction (Hersey and Blanchard, 1982; Matthews *et al.*, 2018), satisfaction and performance (Gu and Chi, 2009; Judge *et al.*, 2001; Park *et al.*, 2017) and performance and achievement (Vroom, 1964), no study can be found that captures the analysis of each dyad separately then interrelatedly links all coupled taxonomies to examine the nuanced effects of the motivation to transfer learning. It is also important to note that the repository of transfer research finds actionality within myriad academic disciplines (i.e. management, HRD, training); that is to say that trained employees can be categorized as *learners* (Baldwin and Ford, 1988; Clark *et al.*, 1993; Lim and Johnson, 2002; van Merriënboer, 1997). This article aims to show the consequential recourses that exist among interlinked dyads when the motivation to transfer learning becomes an intervening force that drives convergent change throughout a controlled learning channel.

Literature review

The nature of the readiness-satisfaction dyad

Susanto (2008) defined employee readiness as a belief, intention and attitude regarding the extent to which change is needed. Armenakis *et al.* (1993) described readiness in terms of an employee's beliefs, attitudes and intentions. Fundamentally, readiness activities equip learners with knowledge and experience to manage and facilitate day-to-day work activities. While no singular constituent can be solely attributed to job satisfaction, employee readiness stipulated a unidirectional prominence that creates an affective or emotional response toward all facets of a job. Both Cunningham *et al.* (2002) and Tetenbaum (1998) posited that the readiness factor was a determining factor for successful organizational change.

Learners who had an active approach in resolving organizational problems scored highest in job readiness dimensions (Cunningham *et al.*, 2002). Bussing *et al.* (1999) identified a positive correlation between job satisfaction and organizational learning theory. In the context of educational practices, contributory methods toward learning outcomes contain valid and reliable appraisals that mediate investment, increase motivation and maximize substance (Brill, 2016; Suen, 2014). Both Brill and Suen primarily focus on the procedural facilitation of learner feedback and significance of the feedback received. Job positions that place greater demands and offer a larger range of decision-making opportunities tend to show more readiness for organizational change (Shah *et al.*, 2017). Messmer (2000) found that an

intentional investment in work training and career development not only increases readiness but also contributes to employee retention.

Job satisfaction is not a static phenomenon and is influenced by job or work factors (Lam, 1995). The study by Walker and Campbell (2013) found that job readiness predicted job satisfaction and work engagement. Employee engagement serves as a learning process in which employee control personal behaviors and goals (Osborne and Hammoud, 2017). Additionally, this study revealed dimensions of job readiness and job satisfaction to act as mediators between job acumen and intention to stay. Job satisfaction is not a static phenomenon and is influenced by job or work factors (Lam, 1995). Other studies support readiness as a predictor in job satisfaction. A study by Walker and Campbell (2013) found job readiness predicted job satisfaction and work engagement. The study by Walker and Campbell found dimensions of job readiness and job satisfaction to act as mediators between organizational acumen and intention to stay. Hersey and Blanchard (1982) believed the consequential effect of employee readiness reflects a prescriptive model that granularly produces moderate levels of maturity through active participation in decision-making. Latif (2012) found that employee retention was majorly affected by employee-focused learning development. As learning and self-efficacy increases, they become more connected, satisfied and enthused about all facets of their job (employee readiness → job satisfaction).

The ideal relational construct that entails an autonomous and self-regulating culture within the readiness-satisfaction paradigm promotes development through delegation. According to Leana (1987), delegation promotes and encourages individual achievement by assigning individual responsibilities and authority to dependent employees. This construct is suitable for employees that view independence as an opportunity to utilize developmental mechanisms to make independent decisions. Accordingly, independence induces an acuity of sense-making systems that render cultural regulation inadequate and intentionally places learners in prescriptive learning climates that arouses cognitive growth and problem-solving dexterity.

Noe and Schmitt, 1986 posited that learners develop an affinity toward knowledge acquired through formal and informal learning climates which can alter attitudes, interests, values and perceptions toward work groups and task structure. Readiness outcomes influence behavioral changes that shift motivation to apply knowledge gained through learning to job-specific context (Egan *et al.*, 2004). Consequently, employee expends more time and effort, assumes greater responsibility, orients and identifies with the organization. Adversely, when learners resort to withdrawing from learning activities, hiding identities, ideas and feelings, and disengaging from institutional interests, performance decreases (Deci and Ryan, 1985).

The nature of the satisfaction-performance dyad

The relationship between job performance and job satisfaction is meaningful. In an organizational context, job satisfaction is expressed through emotional responses versus something that is observed (Luthans and Thomas, 1989). According to Fatima and Azam (2016), employees view job satisfaction as the extent that job-related intrinsic and extrinsic values, such as the position, payment, opportunities, peers, are met or exceeded. Scullen *et al* (2000) contented that job performance plays the most significant role in personnel decisions impacting pay, promotion and retention.

The relationship between job satisfaction and job performance has been heavily researched. The Hawthorne studies conducted in the 1930s provide a catalyst to link satisfaction to performance. Following the Hawthorne studies, Brayfield and Crockett (1955) reviewed satisfaction and performance studies and found an inconsequential relationship between satisfaction and performance. A meta-analysis conducted by Iaffaldano and

Muchinsky (1985) reviewed 74 previously published studies found the relationship between satisfaction and performance to be relatively low. Alessandri *et al.* (2017) used a latent difference score model to analyze worker satisfaction and found satisfied workers had higher performance levels over more extended periods of time versus unsatisfied workers.

Other researchers have reported significant relationships between job satisfaction and performance (Telman and Unsal, 2004). Lawler and Porter (1967) found that high performance led to higher income, increased promotions and more employee reconciliation. Al-Aameri (2000) found that satisfied learners are imaginative, devoted and emotionally attached to their employers. This study attempts to provide needed evidence to link and supplement the relationship between job performance and job satisfaction.

Nature of the performance-achievement dyad

Previous research supports employee satisfaction is positively correlated with employee-perceived organizational justice that includes the performance appraisal process (Levy and Williams, 1998). Adams (1963) interpreted employee obligation to remain with an organization is higher when there is a perceived positive relationship between one's performance effort and the performance rating. An employee's vantage point of an organization is based on individual reflections of self-beliefs. Learners use different strategies and activities to achieve performance and organizational goals. Morrow (1983) suggested that specific leadership strategies can promote an employee's self-achievement. Chi *et al.* (2008) postulated effective leaders motivate learners and support them to achieve and attain professional goals. Chi *et al.* found that employee satisfaction and organizational commitment increased when a leader's assessment of employee performance aligns with employee self-performance and achievement.

Garg and Rastogi (2006) conjectured that more learning opportunities provide learners with the knowledge needed to perform to confront global challenges. Demonstrative opportunities correlated with achievement standards become normative in content but prescriptive in context. Implicitly, the contextual modality becomes the normative benchmark based on perceived competence, which is antecedent to achievement goals (Elliot and Murayama, 2008). Several authors (Judge *et al.*, 2001) have reconceptualized job performance and job satisfaction typologies and derived that performance leads to satisfying value outcomes. Vroom (1964) theorized a probable perception that an exerted amount of effort produces an achievable level of performance based on conscious expectancy calculations. Locke and Latham (2000) deduced that high objectives and high expectations of success intensify efforts toward achievement based on the goals and needs of the individual (Robbins *et al.*, 2017). Knowles (1969) suggested that the need for achievement results from an amalgamation of affective response and elevated performance levels. Therefore, if job satisfaction is based on how one feels about all aspects of a job (Ellickson and Logsdon, 2002), intrinsic and extrinsic sources have a significant causal effect on overall job satisfaction and motivation.

Learners have the tendency to adopt feelings of boredom and futility if performance goals have been exhausted and learning potentialities are depleted, due to reducing or eliminating all deficiencies with no relevant control mechanisms, thus becoming less dependent of growth externalities. In other words, learning becomes decontextualized, such that the relevance and utilization of knowledge decreases in value without available learning activities and preparation for future learning (Belenky and Nokes, 2012). A declining intrinsic presence might suggest increasing the challenge, interest and relevance of the goal. Similarly, an increase in intrinsic motivation may equate to reducing the external reward systems and contingencies connected to the performance standards (Lepper *et al.*, 2005). Combining both learning and performance dimensions to the achievement modality increases the need for achievement. Self-conceptions become less nebulous, and incremental theories of ability are

validated thought achievement gains. Environmental constructs become conducive to normative motivations aligned with perceiving competencies as mastery standards involve. However, Lepper *et al.* (2005) suggested that performance goals, while extrinsic, have been linked to decreased cognitive engagement and avoidance of challenge.

Motivation to transfer learning among to readiness, satisfaction, performance and achievement dyads

Porter *et al.* (2003) describe motivation as the force that energizes, directs and sustains behavior. Motivation consists of energy, direction and persistence (Fard *et al.*, 2010). According to Manzoor (2012), motivation symbolizes a procedure initiated through psychological and physiological needs dispensed toward a specific objective. Kroth (2007) postulated that motivation might increase with work customization. Notably, motivation is the product of an exponential reverberation of expectancy, instrumentality and the attractiveness of the specified goal (Vroom, 1964). Implicit and explicit reinforcement form a modeled behavior if presented with positive incentives or rewards. Harter (1981) suggested that the collaboration between intrinsic interests and extrinsic rewards acts as a tool to motivate learning. Maehr and Nicholls (1980) inferred that an intrapersonal requisite generates a subjective standard for learning used to evaluate competency as a part of goal achievement to measure mastery.

Skinner (1953) theorized that behaviors that result in positive outcomes are recurrent, and behaviors that result in adverse outcomes are not. If the valence of the reward lacks an affective investment, the individual can conceivably become demotivated, although a certain level of effort was calculated and exerted, the performance was achievable, and the reward was certain. Contrariwise, the presence of a practical component can be counterintuitive and operationalize ways to avoid mastery attempts for fear of failure. Mastery-based standards assess competency levels based on the positive possibility to succeed or a staunch avoidance of failure (Elliot and Harackiewicz, 1996). Motivation through intrinsic and extrinsic sources reinforces behaviors that are learned better, given more attention and performed more often (Robbins *et al.*, 2017).

Lunenburg (2011) explained that a multiplicative effect that construes (1) an exertion of deliberate effort would produce a perceived level of performance, (2) a perceived level of performance is instrumentally manipulated in procuring the desired outcome and (3) an allocated value is advertently attached to the outcome or reward. Meaning, if $A \neq B$, $B \neq A$, or if $C = 0$, then no motivation exists. If an individual believes that expending a certain level of effort will produce a heightened level of performance, however, if the improbability of being rewarded is substantiated, then the individual becomes demotivated. Alternatively, if an individual assumes the probability of being rewarded for a certain level of performance but appraises the effort needed to perform a task successfully as impossible, the individual will not be motivated and avoid the task.

Conversely, learners can cognitively evaluate situational contexts and determine deficient psychology and emotional deficiencies. The theoretical scaffold is construed by models that emphasize the behavior \rightarrow attitudes (attitudes follow behaviors) paradigm (Dickson, 1973). Consequently, the negative feedback loop stops and growth potential halts. Heylighen (1992, 2014) asserted that the virtue of openness to experience creates an eagerness to undergo new experiences, learn new ideas and skills and trying new things. Accordingly, existing schemas and ego-cultures are contradicted, resulting in the challenge of schematic acuties. This venture into the unknown motivates self-actualizers to intuitively and rationally understand contradictory perceptions while purposely detracted from denying, repressing or deforming novel observations. Subtly, there exists a predisposed notion enact competitive undertones existent between the mastery- and performance-approach. The need to master certain task

levels suggestively affects performance levels, which augments the need to learn more (Harackiewicz *et al.*, 1998). Tendencies to exponentially strengthen self-efficacy increases while maintaining an intrapersonal control that creates an awareness of oneself. The goal becomes actualized when conceptualizing the learning activity as a cognitively represented aim separated by the intentionality for pursuing the goal (Elliot and Thrash, 2001).

Theoretical framework and model

This study aims to examine a reconceptualized framework that disaggregates theoretical relationships to measure the multiplier effect, or motivational sequence, based on hypothesized dyad conjectured by theory or empirical research. This study examines the multidimensional coupling of relational correlates and the associative effects of learning transfer among each dyad. The proposed theoretical framework assumes the disposition of systems theory; meaning that behavior of each relational dyad directly affects the overall behavior of the entire transfer system. Rather than triggering an independent effect on the entire system, each dyad has associative effects that are interdependent and work interconnectedly to move toward equilibrium within the entire system (Skyttner, 1996).

Specifically, the cyclical model (see Figure 1), using elements of the double transfer model (cf. Figure 1, Schwartz and Martin, 2004) implies that acquired knowledge generates a motivation to transfer learning in real-world situations, which initiates competence awareness (*readiness*), or mastery-approach (Elliott and Murayama, 2008). Knowledge is believed to be *transferred out* if its use is suitable to solve new problems outside the boundaries of the original learning construct (Belenky and Nokes, 2012). As readiness increases attributable to repetitive usages of knowledge, behavioral retorts are mediated by intrinsic factors (i.e. autonomy and environmental control) that trigger a favorable effect (*satisfaction*). The readiness-satisfaction dyad denotes the origin of learning characterized by hands-on inventions or instructional activities (Schwartz and Martin, 2004). Equally, knowledge acquired transfer out through a feedforward mechanism that helps mitigate the fear of failure and increase pre-emptive measures to reduce uncertainty (Goldsmith, 2003).

As satisfaction increases, customized arrangements of activities are intentionally compiled to accomplish a specific goal or set of goals (*performance*) as knowledge *transfers through* the learning continuum or channel. Within the transfer climate (e.g. work environment), concurrent controls symbolize supervisory and peer support, opportunities to perform and accountability (Burke and Hutchins, 2007). Several researchers addressed leadership theories that denoted the latitudinal empowerment (i.e. influence in decision-making, open communications, confidence) and independence given by subordinate-oriented boss (Hersey and Blanchard, 1982; Tannenbaum and Schmidt, 1975; Harris *et al.*, 2011).

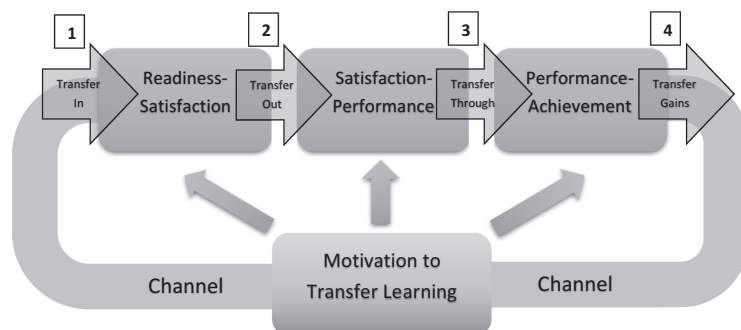


Figure 1. Cyclical effect connecting readiness, satisfaction, performance and achievement. Note that motivation to transfer learning is an internal variable present of each dyad

According to Vroom (1964), performance levels based on calculative efforts exerted results in the accomplishment of the goal itself (achievement). When culminated at the end of the continuum, knowledge amassed through replicative uses within the channel is now suitable to be transferred into new learning situations (Belenky and Nokes, 2012). After achievement goals are complete and evaluated, learning interventions can be designed to provide learners with timely feedback, reinforcement and remediation to help improve the mastery-approach (Lee and Kahnweiler, 2000; Salas *et al.*, 1999). Belenky and Nokes (2012) found that learners who were able to experience procedural invention and instructional activities into worked examples prior to the prospective problem increased in motivation to *transfer in* learning to new learning situations.

The theory assumes a causal effect that signifies an evolution of mastery after achievement is reached. Learning transfer and mastery-approach remain the pivotal variables that drive the exponential change throughout the cyclical recurrence. Specifically, motivation and learning act as proximal filters that foster intrinsic properties that externally regulate the outward transference of learning in a situationally, physically and emotionally governed *channel* (Baard *et al.*, 2004; Gegenfurtner *et al.*, 2009). The channel acts as a conduit in which mastery becomes a derivative product of replicative learning and is granularly attained over time (Baldwin and Ford, 1988). The range between readiness and achievement where acquired knowledge become applicative and replicative within controlled environments are proximal predictors that generate achievement outputs such as intrinsic motivation and performance attainment (Elliott and Church, 1997).

The model postulates the following theoretical linear and cyclical sequence: (1) knowledge and skills gained by the employee through hands-on inventions or instructional activities are *transferred in* to new learning situations, (2) *transferred out* to solve problems external of its origin point by performing task- or situation-specific activities, (3) utilized and *transferred through* the learning continuum to achieve goals and (4) assessed to determine *transfer gains* (increase in learning) that will be used to *transfer in* to new and upcoming situations. This cycle of transference stimulates the employee inwardly (emotionally and cognitively) as the flow of learning (knowledge and skills) (Noe and Schmitt, 1986) transmits among relational dyads while outputs of each dyad (i.e. application of knowledge, performing tasks, completion of goals) are produced outwardly (situationally and empirically).

As achievement success increases, complicated tasks are more likely selected as personal challenges are dominated (Bigge and Hunt, 1980), and constructive appraisals are provided. Conversely, if achievement success declines, more manageable tasks are more likely to be selected to reduce the fear of failure. At this juncture, competency-based on intrapersonal standards of absolute mastery is demoted self-conceptions of ability (Elliott and Murayama, 2008). Intrapersonal incompetence and task-based avoidance become antecedents to performance-avoidance, which fails to scaffold intrinsic motivation as a relevant contributor in part (Elliott and Murayama, 2008). To surmise, if the motivation to transfer learning increases among all dyads, the cycle perpetuates. Alternatively, if transfer learning decreases, the cyclical progression either ceases to initiate, protract or discontinue.

Hypothesis and methodology

Based on the literature surrounding job performance and satisfaction paradigms and expectancy theory, this article tests the following hypothesis:

- (1) Hypothesis 1: An increase in motivation to transfer learning among one or more relational dyads generates a continual cyclical effect among readiness, satisfaction, performance and achievement.

- (2) Hypothesis 2: A decrease in motivation to transfer learning decreases among one or more relational dyads generates a cyclical effect that protracts or rests.
- (3) Alternative Hypothesis 1: Motivation to transfer learning has no effect on any relational dyad and no cyclical effect occurs.

This study aims to test if a direct link exists between Matthews *et al.* (2018) readiness-satisfaction dyad, Park *et al.* (2017) satisfaction-performance dyad, and Vroom (1964) performance-achievement dyad. This study is conducted through a critical realist and pragmatic paradigm which justifies a mixed-methods approach that incorporates qualitative and quantitative data within a neural network. This research finds it necessary to capture the richness of business societal interactions through a mixed-methods approach as one methodology does not capture the complexities of the interconnected systems. This study fills a literary gap by utilizing neural networks to create empirical and rational knowledge that incorporates the quantitative side, which is often neglected in motivational research studies.

This research utilizes triangulation in a quantitative and qualitative sequential mixed-methods approach by combining conceptual frameworks of the dyads through a neural network methodological approach. Similarly, Modic *et al.* (2019) conduct a study that discusses using neural networks to choose an appropriate method and then integrating both qualitative and quantitative data through machine learning. When choosing an approach, this research turned to the related literature to choose an appropriate methodological framework, illustrated in Figure 2, to apply to this research study.

This study layers the satisfaction-performance dyad (Park *et al.*, 2017) on top of the performance-achievement dyad and readiness-satisfaction dyad to understand how motivation accelerates, slows and possibly halts throughout each node of the network. Through this approach, we created an algorithm that allows us to model the dyad cycle with a machine learning neural network to understand the flow of motivation energy through the progression of the variables. The Artificial Neural Network, or ANN, utilizes a binary system to codify the level of motivation energy that exists between each biological cell within the neural network. Then, after the algorithm is codified into a binary numerical system, it will

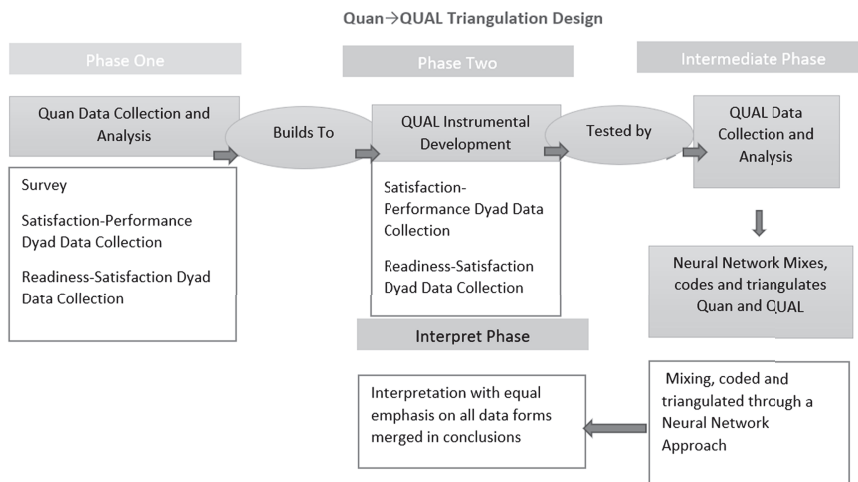


Figure 2.
Quan → QUAL
triangulation design

Source(s): Tashakkori and Teddlie (1998) and Herzberg *et al.* (1959)

flow through a threshold logic unit to derive the energy to fire through the biological process. If the TLU is positive, then it can fire through the next biological cell and flow through the dyads. Using a threshold logic unit to derive outcomes, this simulation method measures how energy impacts the dyads throughout the biological cell cycle with a multiplier effect.

To program the neural network model for the readiness satisfaction dyad, each variable is assigned the appropriate Likert scale as assigned by the research survey outcomes and weighed by the neural network. The survey tool establishes eight choices for leader-member relations, four choices for maturity level and willingness to do the work, four choices for Hersey and Blanchard (1982) situational leadership theory, seven hygiene factors based on a 1-10 satisfaction on a Likert scale, and the level of actualization based upon Maslow's Hierarchy of Needs (see Figure 3).

Figure 4 shows the leader-member relations portion of the algorithm is determined by four maturity levels, as researched by Hersey and Blanchard (1982) and are assigned their appropriate letter designations.

Hersey and Blanchard's (1982) situational leadership theory is based on a dyad between leadership style and the maturity level of those being led. Within this dyad, leadership styles

Readiness Satisfaction Dyad Algorithm: $RSD = lmr1 > IV \rightarrow ml \geq 3 \rightarrow hb \geq 3 \rightarrow hf \geq 5 \rightarrow M \geq 3$ $RSD = lmr1 < V \rightarrow ml \leq 2 \rightarrow hb \leq 2 \rightarrow hf \leq 5 \rightarrow M \leq 2$ RSD	
Variable Code	Measurement
w	Weight
lmr	leader-member maturation
MI	Maturity level
hb	Hersey-Blanchard situational leadership theory
IV	Category 4 on the leader-member correlation matrix
hF	Hygiene factors
V	Category 5 on the leader-member correlation matrix
M	Maslow's hierarchy of needs actualization level

Sources(s): Maslow (1954); Hersey and Blanchard (1982); Vroom (1964)

Figure 3. Readiness-satisfaction dyad algorithm

M-1	basic incompetence or unwillingness in doing the task
M-2	inability to do the task but willing to do so
M-3	competent to do the task but do not think they can
M-4	the group is ready, willing, and able to do the task.

Source(s): Hersey and Blanchard (1982)

Figure 4. Leader-member exchange dyad algorithm

stem from four basic behaviors, designated with a letter–number combination. The algorithm assigns the appropriate number to the respective leadership style, which is represented in Figure 5 below.

Then, the survey measures the level of satisfaction of the following hygiene factors:

- (1) Supervisors;
- (2) Working conditions;
- (3) Interpersonal relations;
- (4) Pay and security and
- (5) Company policies and administration.

Next, the neural network assigned the actualization level on Maslow’s hierarchy of needs pyramid. The number assignment designation is as follows: (1) psychological, (2) safety, (3) belongingness, (4) esteem and (5) self-actualizations.

To see how motivation increased, decreased or halted performance energy, the model overlaid readiness satisfaction with the satisfaction performance to understand the flow of motivational energy. Vroom’s (1964) model of performance achievement makes the indications of the TLU to measure energy outcomes. In the research of Vroom, three variables indicated motivation, which included the linkage of A performance and effort, B the linkage of performance and rewards, and C attractiveness or valence. In other words, if $A \neq B$, $B \neq A$, or if $C = 0$, then no motivation exists.

Then, the ANN overlays the research of Park *et al.* (2017), which determines why high performers feel dissatisfied when role overload (resource outflow) exists and how external resources impact performance and role satisfaction (resource inflow). The research of Park *et al.* discovered that role overload decreased high performers’ job satisfaction. The leader–member exchange social comparison (LMXSC) increased high performers’ job satisfaction because of the exclusive resources attained. According to this study, job satisfaction was lowest when resource outflow from role overload was not traded off by the resource inflow of LMXSC (Park *et al.*, 2017). Figure 6 represents the algorithmic utilization of the machine learning employed to communicate among dyadic nodes.

Finally, the weight for each variable, as determined by the ANN, is passed through a sigmoid function to codify it into a binary construct. This summation is then normalized through a sigmoid function:

$$\frac{1}{1 + e^{-x}}$$

Sample

The sample selection for this study is guided by the sampling methods utilized by researchers perusing to understand readiness-satisfaction, satisfaction-performance, performance-achievement motivation and organizational learning (Fard *et al.*, 2010; Gu and Chi, 2009; Matthews *et al.*, 2018; Poloski-Vokic *et al.*, 2008; Vroom, 1964). This study utilizes a

S-1	Telling
S-2	Selling
S-3	Participating
S-4	Delegating

Source(s): Hersey and Blanchard (1982)

Figure 5.
Leadership style
coding

probability and deliberate sampling approach to obtain information about employee and employer relational dyads in a simulation within the workforce population of east Texas. Survey data of 320 supervisor–employee dyads across seven major industries in the East Texas region are collected in this study. The sample includes 160 supervisors and 160 lower-ranking employees. The demographics of supervisory level respondents include a mean age of 47 years, with 15 years of industry-related experience, and reports an average tenure of four years in their current roles. The nonsupervisory component of the data sample includes respondents with a mean age of 32 years, seven years of experience in their fields, and three years of tenure in their current roles. The sample includes 55% men and 45% of women participants. Figure 7 represents additional details about the sample utilized in this research study.

Data results

This study accepts the hypotheses that motivation to transfer learning creates a multiplier effect among the readiness-satisfaction dyad when learning is present, which triangulates Matthews *et al.* (2018), the satisfaction-performance dyad from Park *et al.* (2017) and the performance-achievement dyad of Vroom (1964). The data substantiate the multiplicative effect of job readiness, satisfaction, performance and achievement, both positively and negatively, depending on the trajectory of the motivational factor, even when learning is present. Thus, the presence of motivation causes a cyclical effect that perpetuates among relational dyads. The data reveal that when motivation wanes or ceases among one or more

LMXSC↑JS=LMR+JS-D→RO	
Variable Code	Measurement
RO	Resource Outflow
D	Dissatisfaction
LMXSC	Leader-member exchange social comparison
JA	Job Satisfaction

Source(s): Hersey and Blanchard (1982); Matthews *et al.* (2018); Park, Chae, and Kim (2017); Vroom (1964)

Figure 6. Machine learning process algorithm for neural network

GENDER	Male (55%), female (45%)
AGE	Supervisor mean = 47 years old; non-supervisor mean= 32 years old
HIERARCHICAL LEVEL	28% Executive level, 12% middle managers, 12% low-level management, 50% non-supervisor/managers
INDUSTRY	Hospital (12%), hospitality (22%), manufacturing (35%), education (12%), government (10%), banking (9%)
SIZE OF COMPANY	0-50 employees (30%), 50-100 employees (50%), 100-500 employees (12)%. 500+ employees (8%)

Figure 7. Research sample for machine learning process

dyads, the cyclical effect begins to retract and, eventually, stop. The implication of ignoring the applied effect that motivation has on job readiness, satisfaction, achievement and performance leave researchers and managers with ineffective and nonapplicable models to judge the motivational phenomenon.

Based on the neural network model computations, the results are statistically significant, with a p -value of 0.00. Further the R2 indicates that the readiness-satisfaction dyad, the satisfaction-performance-dyad and the performance-achievement dyad have an R2 of 88%, signifying a direct correlation. The SD when commutating the survey results from the dyadic comprises readiness, satisfaction, performance and achievement without motivation resulted in 3.89, whereas the standard 2.53, which makes motivation a variable that sways consistency toward positive performance outcomes. The standard error of the mean dropped from 0.22 to 0.14 when motivation was present. The following chart presents the statistical outcomes of satisfaction, readiness, performance and achievement in this research study.

The null hypothesis is rejected and both alternative hypotheses are accepted as the t -statistic of 0.20 is less than the critical two tail distribution of 0.84. Moreover, the line graph (see Figure 8) presents the exactitude at which correlation is generated.

The algorithm yielded $\mu = 6.0$ in the sample that did not incorporate motivational vectors and $\mu = 2.95$ with an underlying motivational driver (see Table 1).

Interestingly, the difference between both valuations was 3.05, which indicates that motivation is a substantial multiplier effect across performance, achievement and readiness. Furthermore, the neural network model was successful in back-propagating motivation and how it impacts the dyads through a cyclical feedback loop.

Discussion and conclusion

A neural network approach is used in this study to triangulate if a multiplicative exacerbation exists when motivation transpires between nodes to understand the effect of transfer learning among dyads. This study shows that an elevated presence of motivation to transfer learning serves as a prerequisite to maintain an active cyclical and recursive effect between all hypothesized dyads. Inversely, when motivation to transfer learning decreases among dyads, the cyclical effect theoretically retracts and, eventually, stops. Marginal opportunities to actively use acquired skills on the job directly impedes transfer learning while opportunities to utilize trained skills constitute a prerequisite to successful knowledge transfer (Clarke, 2002; Lim and Johnson, 2002).

The continual presence of motivation to transfer learning and the correlative effect on each dyad show a progressive transfer of knowledge persists when intrinsic and extrinsic

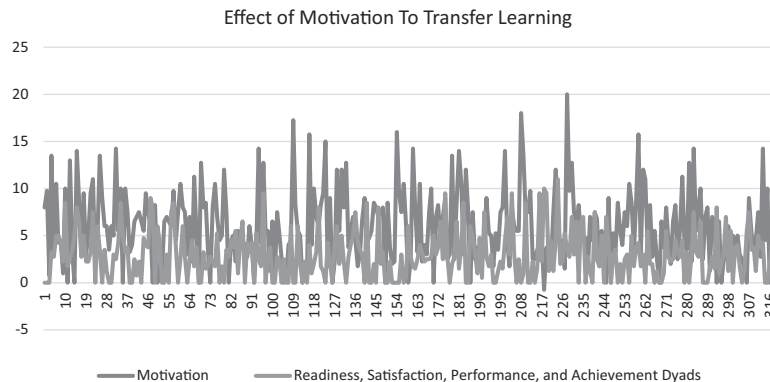


Figure 8.
The causality between motivation and readiness, satisfaction, performance and achievement dyadic

Readiness, satisfaction, performance and achievement dyads with motivation		Readiness, satisfaction, performance and achievement dyads with motivation		Difference
Mean	6.003125	Mean	2.94921875	3.05390625
Standard error	0.217468467	Standard error	0.141879952	0.07558852
Median	5.5	Median	2.75	2.75
Mode	0	Mode	0	0
SD	3.890194197	SD	2.538025733	1.35216846
Sample Variance	15.13361089	Sample Variance	6.441574633	8.69203627
Kurtosis	0.273043432	Kurtosis	0.034275479	0.23876795
Skewness	0.640601599	Skewness	0.767640106	-0.12703851
Range	20.75	Range	11	9.75
Minimum	-0.75	Minimum	0	-0.75
Maximum	20	Maximum	11	9
Sum	1921	Sum	943.75	977.25
Count	320	Count	320	0
Confidence level (95.0%)	0.427853635	Confidence level (95.0%)	0.279138645	0.14871499

Table 1. Statistical outcomes of readiness, satisfaction, performance and achievement

cues remain resonate in mastery-approach and achievement goals. This study further establishes a dyadic linkage between the job readiness and satisfaction model Matthews *et al.* (2018), the satisfaction and performance (Gu and Chi, 2009; Judge *et al.*, 2001) and the expectancy model (Vroom, 1964). The continual presence of motivation and the correlative effect on paradigmatic variables show progressive matriculation through relational dyads that persist if intrinsic and extrinsic factors remain to resonate in goal attainment.

According to the neural network model, the findings indicate that as motivation to transfer learning increases among one or more relational dyads, a multiplier effect stimulates a continuous loop among readiness, satisfaction and performance. The implications of ignoring the applied effect that motivation has on readiness, satisfaction, achievement and performance leaves managers with ineffective and nonapplicable models to judge the motivational phenomenon. Gegenfurtner *et al.*, (2009) emphasized the simultaneous presence of self-determination theory (Baard *et al.*, 2004) and expectancy theory (Vroom, 1964), which decisively administers cognitive-choice and need-motive-choice approaches that theoretically predicts and empirically explain human performance. The implicit and explicit cruxes within the unidirectional channel reflect internally motivated behavior used to assess an intrapersonal assessment of competence and externally prompted reasons to transfer knowledge within a controlled environment applicably.

Based on the theoretical framework used in this study, motivation to transfer learning governs concentrated efforts and performance energy (motivation) indicative of foreshadowing outcome actualizations. Vroom (1964) and Herzberg *et al.* (1959) asserted that the nexus between expectancy and goal attainment congregates valuative calculations of assumptive performance outputs within environments with combined intrinsic (motivators) and extrinsic (hygiene) factors which generate an affective response creating a transfer climate suitable for mastery- and performance-approach. Increasingly focused on hygiene factors, Colquitt *et al.* (2000) found a strong correlation between environmental climate (channel) and transfer activities. Additionally, environmental climates need vetting before knowledge transference becomes the expectant catalyst to increase skill application (Burke and Baldwin, 1999; Richman-Hirsch, 2001). Lim and Johnson (2002) found that higher transfer activities were more prevalent when achievement goals matched departmental goals.

The motivational model created by the neural network within this study was substantiated with statistical accuracy and validated the amalgam of effects of motivation as learners reach a

higher level of readiness, satisfaction, performance and achievement through homogeneity of lower-level phenomena. Based on this derivative, managers must focus on incorporating and linking local decisions derived from the transfer of knowledge (*transfer in*) to daily work operations (*transfer out*) that significantly align individual performance outcomes to systemic organizational goals can further encourage the transfer of learning (Lim and Johnson, 2002). Furthermore, job design should be centered on one's skills, abilities and preferences (Robbins *et al.*, 2017). This customization can purportedly match one's self-efficacy, whether task- or situation-specific (Bandura, 1997). Barron and Harackiewicz (2001) found that circumstantial situations mediate adaptive patterns of learning based on extrinsic motives associated with performance goals. Managers should (1) develop task- and situation-specific training activities there are aligned with intrinsic cues and organizational goals, (2) provide learning transfer mechanisms of positive feedback loops that develop capacities, thus meeting intrapersonal standards of improving remaining potentialities and (3) create structured climates suitable for learning convey *transfer gains* into new situations.

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<https://www.emerald.com/insight/2444-8494.htm>

Building reputation through sustainable supplier selection: the case of an emerging economy

Sustainable
supplier
selection

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Received 2 December 2019
Revised 23 February 2020
2 March 2020
16 March 2020
Accepted 17 March 2020

Abstract

Purpose – The purpose of this research is to examine the drivers of sustainable supplier selection (SSS) and investigate the extent to which it is associated with a buyer's financial performance within an emerging economy context.

Design/methodology/approach – The data were collected from 235 supply chain and procurement professionals in Thailand. The structural relationship was tested using partial least squares based structural equation modeling (PLS-SEM) and PROCESS tool.

Findings – Based on the empirical findings, firms that pursue sustainability initiatives during supplier selection process enjoy better financial performance than their competitors. The analysis suggests six hypothetical paths explain SSS. Suppliers' human rights and safety focus are the most powerful determinants of SSS. Significantly, positive support was found for the SSS and buyers' financial performance relationship. Finally, there is a significant moderating effect of resource investment on sustainability efforts.

Research limitations/implications – Data for the study were collected from a single industry, so the findings are indicative but not representative of all supply chains. Due to this limitation, the findings cannot be generalized across other countries and industries. This study is a starting point in understanding the role of SSS in creating a sustainable supply chain. Future research may develop a comprehensive understanding of the nature and magnitude of the impact of SSS on sustainable supply chains.

Originality/value – This paper contributes toward an understanding of the determinants of SSS and its consequences for sustainable supply chains.

Keywords Sustainable supplier selection, Purchasing social responsibility, Financial performance, Supply chain management, Stakeholder theory

Paper type Research paper

1. Introduction

Many of the global supply chains rely on emerging economy suppliers for their sourcing decisions due to various reasons, such as close proximity to markets, close proximity to manufacturers, quality, delivery, flexibility and skilled and low-cost labors. In recent years, the reputations of many organizations have been at stake by the questionable practices of their suppliers owing to sustainability issues (Foerstl *et al.*, 2015). There is ample anecdotal evidence suggesting that firms can suffer severe losses due to social, ecological or ethical problems hidden in their supply chains. To make things even worse, they know very little about the



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European Journal of Management
and Business Economics
Vol. 29 No. 3, 2020
pp. 315-332
Emerald Publishing Limited
e-ISSN: 2444-8494
p-ISSN: 2444-8451
DOI 10.1108/EJMBE-12-2019-0217

magnitude of sustainability issues that emerge as risks and how those risks eventually impact focal firms to suffer losses (Hofmann *et al.*, 2014). For example, Chowdhury (2017) describes the Rana Plaza (Bangladesh) tragedy which triggered international outrage, forcing reputable US and European clothing brands to improve safety conditions at their supplier factories. Incidents such as these emphasize the need for more research into supplier selection, social responsibility and sustainability. Despite the renewed call for research focusing on sustainability in purchasing and supply management (Thornton *et al.*, 2013; Kumar and Rahman, 2016), the challenges of identifying sustainable suppliers are still under-explored.

The process to sustainable supply chain practice begins with sustainable suppliers. Carter and Easton (2011) suggest that firms should not select suppliers purely based on price, delivery and service quality but also on their ability to integrate sustainability into their business practices. Buying firms are paying close attention to sustainability compliance as scandals can damage their business (Koplin *et al.*, 2007). Reuter *et al.* (2010, p. 46) defined sustainability as “the tripartite pursuit of economic, ecological, and social performance,” which Elkington (1998) named the “triple bottom line” of an organization. The purpose of this study is to explore the drivers of sustainable supplier selection (SSS) and its impact on firms’ financial performance. Donaldson and Preston (1995) argued that commitment to sustainability comes at a cost, and stakeholder pressures are the drivers of SSS phenomena in the supply chain. Building on stakeholder theory, the current study addresses the SSS issue by examining how socially responsible purchasing practices which are measured by the purchasing social responsibility (PSR) dimensions, such as customers, the government, employees and the society at large as primary constituencies of the firm, determine the extent to which firms consider sustainability aspects in the selection of emerging economy suppliers. Further, we analyze how SSS relates to the firm’s financial performance, which eventually reflects its market reputation.

On this backdrop, current study aims to examine the role of SSS on financial performance within an emerging economy context by addressing three research questions: (1) *What are the links between the purchasing social responsibility (PSR) and SSS?* (2) *Is SSS associated with firms’ financial performance?* (3) *Does a firm’s investment in sustainability programs impact the SSS-financial performance relationship?* To approach these research questions, the researchers develop a research framework using stakeholder theory.

2. Literature review

2.1 Purchasing social responsibility (PSR)

Carroll (1979) defined PSR as “purchasing activities that meet the ethical and discretionary responsibilities expected by society.” Carter and Jennings (2004) examined the role of PSR in supply chain management, theoretically and empirically. The dimensions of PSR include diversity, environment, ethical or fair treatment, human rights, community focus and safety. The dimensions of PSR are closely related to those of corporate social responsibility (CSR) and embedded within the central tenets of stakeholder theory. Consumer perception of a firm’s CSR activities positively influences their view of the company, customer satisfaction, loyalty and hence financial performance (Feng *et al.*, 2017).

Global sourcing has become a prominent topic in the field of purchasing and supply management (PSM) and leads to the emergence of PSR (Monczka *et al.*, 2008). Moreover, Munro *et al.* (2018) also argue that CSR initiatives must be relevant to stakeholders and local market needs. Hence, sustainability encompasses the tripartite pursuit of economic, environmental and social performance, the triple bottom line (Carter and Rogers, 2008). The PSR makes the firm responsible for sustainable processes on suppliers’ premises. Any failure or irresponsible actions of suppliers reflect on the buying firm, and may lead to loss of reputation and legal obligations (Koplin *et al.*, 2007; Panahifar *et al.*, 2018). In line with earlier studies by Carroll

(1979), Carter and Jennings (2004), Munro *et al.* (2018) and Carter and Rogers (2008), in this study, PSR has been defined as *a set of purchasing practices that encompass the ecological, social, ethical, economic and discretionary responsibilities expected by society.*

2.2 Sustainable supplier selection (SSS)

The term sustainability encompasses an integration of social, environmental and economic responsibilities. In a McKinsey and Co. (2014) global survey, 43% of 3,344 executives representing the full range of industries, regions, company sizes and functional specialties reported their companies seek to align sustainability with their overall business. This result was up from 30% in 2012. Sustainable supplier selection (SSS) is a critical step toward creating a sustainable supply chain which is defined by Carter and Rogers (2008) as, “the strategic, transparent integration and achievement of an organization’s social, environmental and economic goals in the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its suppliers [and customers]” (p. 368). Drawing on the extant literature (e.g., Carter and Jennings, 2004, 2002a, b; Walker and Jones, 2012), the central focus of this study is to integrate supplier selection, PSR and sustainability in the supply chain, and link them to a firm’s financial performance through SSS.

SSS is treated as a multidimensional construct and based on studies by Walker and Jones (2012) and Thornton *et al.* (2013), in this study, SSS is defined as, *a firm’s strategic orientation and transparent commitment toward selecting suppliers who are capable of delivering materials through business processes that are environmentally safe, socially responsible and economically viable for improving the long-term performance of entire supply chain.* This definition combines supplier selection, sustainability and PSR in the field of supply chain management. SSS has been operationalized as a higher-order construct and formative construct including six sub-dimensions adapted from Carter and Jennings (2008; 2004; 2002a and b). These dimensions are diversity, environmental, supplier ethical treatment, human rights, philanthropy, safety and commitment to sustainability.

In the sustainable supply chain management (SSCM) stream of research, studies have analyzed the impact of suppliers’ practices on buyers’ financial performance. Thornton *et al.* (2013) found a relationship between socially responsible supplier selection and buyer performance. However, the study addressed only the social dimension of sustainability using buyers’ aggregate practices. This study goes further and considers the ecological, social and economic roles of supplier selection in financial performance. This study provides sustainable supplier selection measures rather than the aggregate practices of the buyer, and analyzes the causal mechanisms through which changes in the SSS influence the buyer’s performance.

2.3 Linking PSR dimensions and SSS

Supplier’s environmental awareness is a prerequisite for socially responsible sourcing. According to Carter and Jennings (2002a) and Carter and Rogers (2008), socially responsible firms ensure that supplier processes and products are environmentally sound. Carter and Jennings (2004) and Carter and Rogers (2008) argued environmental awareness will lead to successful implementation of an SSS initiative. This argument leads to the first research question and related hypotheses (H1–H6):

H1. There is a positive association between a supplier’s environmental focus and SSS implementation.

Suppliers must be judged to be honest/ethical during the supplier selection process (Thornton *et al.*, 2013; Carter and Jennings, 2004). According to Carter and Jennings (2002b), unethical behavior includes lying, misleading or blaming suppliers’ representatives for mistakes that

were not their fault. Munro *et al.* (2018) found fairness in the treatment of suppliers' leads to the successful implementation of SSS. This argument leads to the second hypothesis:

H2. There is a positive association between supplier's ethical treatment and SSS implementation.

Supplier's diversity reflects the extent to which the firms select suppliers belonging to gender or ethnic minority groups (Carter and Jennings, 2004). Firms can play a crucial role by contributing to the development of disadvantaged groups in the society. According to Carter *et al.* (1999), sourcing from minority-owned suppliers plays a key role in strengthening their economic outlook. Carter and Rogers (2008) proposed greater supplier diversity leads to the successful implementation of SSS. This argument leads to the third hypothesis:

H3. There is a positive association between supplier's diversity focus and SSS implementation.

The supplier's human rights dimension represents the extent to which firms actively seek suppliers who emphasize human social issues during normal operations (Carter and Jennings, 2004). According to Culpan *et al.* (2010), as supply chains become more globalized, interest in human rights and ethical treatment of workers by overseas suppliers is growing. Carter and Jennings (2004) and Carter and Rogers (2008) found increased respect for human rights leads to successful implementation of SSS. This argument leads to the fourth hypothesis:

H4. There is a positive association between a supplier's human rights focus and SSS implementation.

The supplier's safety dimension captures the emphasis firms place on potential suppliers' safety-related behavior (Carter and Jennings, 2004). A safe workplace can only be achieved by strict enforcement of safety measures. The significant increase in the number of industrial accidents (Yuan *et al.*, 2010) and work-related injuries (Yu *et al.*, 2012; Chowdhury, 2017) in countries such as China and Bangladesh highlights the need for scrutiny of the potential suppliers' safety conditions and standards. Strict enforcement of safety measures by supplier leads to successful implementation of SSS. This argument leads to the fifth hypothesis:

H5. There is a positive association between supplier's safety focus and SSS implementation.

The supplier's community focus dimension reflects the extent to which firms consider the impact of their supplier choice on the broader community (Carter and Jennings, 2004; Thornton *et al.*, 2013). Firms should consider the involvement of local suppliers and support them. Carter and Jennings (2002a) argue that firms can positively impact the local community by selecting and supporting local suppliers. This argument leads to the sixth hypothesis:

H6. There is a positive association between supplier's community focus and SSS implementation.

2.4 Linking SSS and financial performance

The focus of this study is to investigate empirically the extent to which buyer firms benefit financially from engaging in SSS. SSS is positively related to firms' long-term performance, which includes reputation, loyalty, innovativeness, lead time, quality and responsiveness (Blome *et al.*, 2014). In this case, firms' reputation is reflected through its financial performance due to the fact that the firm capitalizes on its image, "doing well, by doing good." The link between SSS and its outcome can be explained by stakeholder theory. Studies by Preston and O'bannon (1997), McGuire *et al.* (1988) and Cochran and Wood (1984) linked sustainable supplier behavior to economic performance. A firm's business activities are not

always governed by the shareholders' desires, but by supply chain partners and society as a whole. External stakeholders influence the firm and the supply chain, by ensuring that the firm undertakes activities that go beyond the profit-oriented view of shareholders. Firms that consider external stakeholders' interests in making an ethical decision may gain supernormal returns, if those decisions align with internal stakeholder interests (Freeman *et al.*, 2004; Donaldson and Preston, 1995). Carter and Jennings (2004) found a link between PSR practices and financial viability in their meta-analysis.

Based on morality shared end-users, Thornton *et al.* (2013) argue that financial performance improves as firms employ SSS. Carter and Rogers (2008) argue that many firms have recently begun to focus on sustainable supply chain issues, and it seems likely that SSS will be a strong predictor of financial performance. This argument leads to the second research question and related hypothesis: *What is the relationship between SSS and a firm's financial performance?*

H7. There is a positive association between SSS and financial performance.

Chandler (1962) proposed contingency theory suggesting that there are numerous ways that firms may choose to maximize their performance, depending on how they allocate their limited resources. In line with the strategy-structure-performance (SSP) paradigm, Galbraith and Nathanson (1978) argue that a firm's strategy to match with environmental factors will drive the improvement of organizational structure and processes. Miles and Snow (1984) postulate that firms that have proper strategic alignment should perform better. Following this line of argument, firms that strategically pursue SSS will gain more profit. The third research question addresses this, examining the hypothesized moderating effect: *Does a firm's investment in sustainability programs impact the SSS-financial performance relationship?*

H8. There is a moderating effect of a firm's resource investment in social programs on the relationship between SSS and financial performance.

The research model integrating all the hypothesized relationships among variables discussed above is summarized in Figure 1.

3. Methodology

3.1 Measurement instrument

All six dimensions of PSR scales were adapted to form the exogenous variables and measured by scales developed by Carter and Jennings (2004). These six exogenous variables are supplier's diversity focus, supplier's environmental focus, supplier's ethical treatment, supplier's human rights focus, supplier's community focus and supplier's safety focus. The resultant scales are designed to achieve the needs of organizational stakeholders while simultaneously considering ecological, social and economic constraints (Chow and Chen, 2012). The respective measures and SSS dimensions are shown in Table 1. To validate the SSS construct, the researchers followed the literature (e.g. Carter and Jennings, 2008; 2004; 2002a,b; Foerstl *et al.*, 2015; Thornton *et al.*, 2013) and tested its correlation with financial performance. We adopted three items from Thornton *et al.* (2013) to measure buyers' financial performance: (1) comparing sales revenue with other firms in their industry, (2) comparing sales growth with other firms in their industry and (3) comparing change in market share with other firms in their industry.

The questionnaire based on these SSS measures and financial performance measures was developed. We measured SSS using a 7-point Likert scale ranging from 1 (None whatsoever) to 7 (To a very great extent). We measured financial performance by using a 7-point Likert scale ranging from 1 (Much worse) to 7 (Much better). Although the questionnaire was originally developed in English, it was subsequently translated into Thai to facilitate

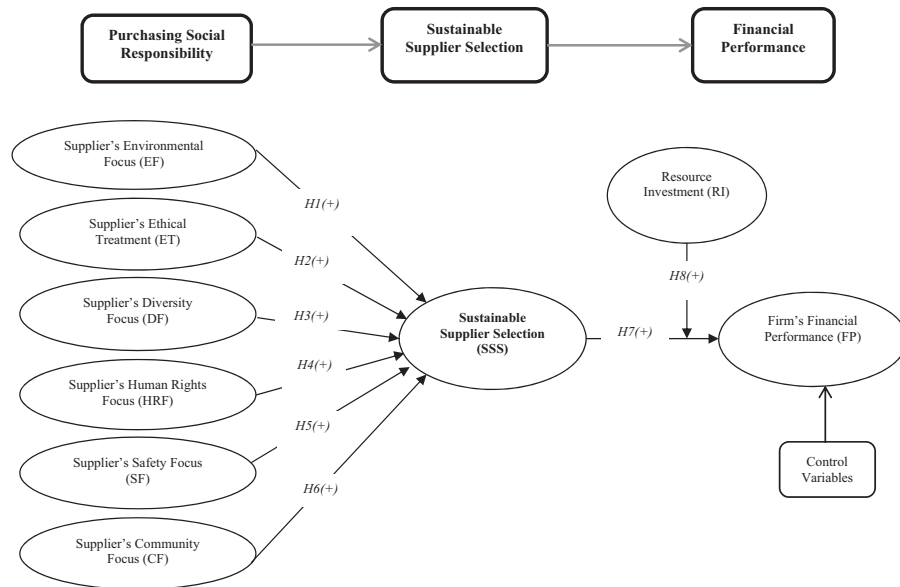


Figure 1.
Research model

respondents' understanding. We followed the approach of Bhalla and Lin (1987) and ensured the linguistic equivalence of the two versions by using the back-translation technique. All measures were professionally translated and back-translated to ensure conceptual equivalence. A pretest was carried out with local professors to refine the measurement items. Using their feedback, we improved the final version of the questionnaire. Table 1 presents the questionnaire on the SSS dimensions and their measures.

SSS in this study has been treated as a mediating variable. Construct correlations are presented in Table 2. It was concluded that all scales were valid and reliable. The moderating effect of resource investment in social programs was included to determine whether tangible investments would financially differentiate firms from those adopting SSS principles but without investing in any other programs. The social program investment variable was composed of a four-item scale tapping investments in (1) SSS-related technology/innovations, (2) resource endowment to benefit underprivileged social groups, (3) providing jobs for the disabled, (4) supporting education/culture/arts programs, (5) investing in local economic development and (6) investing in national economic development. The social program investment scales were adopted from Thornton *et al.* (2013).

Control Variables. Due to the possible impact of external environmental and internal firm-level characteristics on the relationships between SSS and its dimensions and firm-level outcomes, several control variables were included. These measures were reflected by the *workforce size* (number of employees), *age* and *annual revenue* at the company level, along with an *industry sector* and *ownership structure*. The detailed description of control variables is given in Table 1.

4. Data analysis

4.1 Reliability analysis

The assessment of the individual reliability of the items depends on examining the standardized factor loadings. A widely recognized rule of thumb is to accept items with

Constructs	Code	Item wording	S.L	S.E	t-value ^{1,2}	A	C.R	AVE ³	VIF
Sustainable supplier selection (SSS)		Please indicate your choice on a scale 1 = No extent whatsoever to 7 = Very great extent				0.94	0.95	0.77	3.24
	SR1	We seek suppliers based on their reasonability toward the environment	0.87	0.02	34.91				
	SR2	We seek suppliers based on their reasonability toward diversity	0.91	0.01	64.24				
	SR3	We seek suppliers based on their reasonability toward human rights	0.91	0.02	56.84				
	SR4	We seek suppliers based on their reasonability toward philanthropy	0.89	0.02	38.76				
	SR5	We seek suppliers based on their with reasonability toward safety	0.89	0.02	45.77				
	SR6	We seek suppliers based on their commitment to sustainability by addressing/balancing environmental, social and economic perspectives in their business decisions	0.76	0.04	21.56				
Resource investment in social programs (RINV)		Please indicate your choice on a scale 1 = Extremely unimportant to 7 = Extremely important				0.94	0.95	0.77	3.20
	RINV1	Investment in SRSS-related technology/innovations	0.87	0.05	19.14				
	RINV2	Resource endowment to benefit underprivileged social groups	0.98	0.02	39.25				
	RINV3	Providing jobs for the disabled	0.87	0.05	17.59				
	RINV4	Investing in local economic development	0.73	0.07	10.6				
	RINV5	Supporting education/culture/arts programs	0.74	0.07	10.9				
	RINV6	Investing in national economic development	0.72	0.09	7.94				
Supplier's diversity focus (SDF)		Please indicate your choice on a scale 1 = Strongly disagree to 7 = Strongly agree				1.00	1.00	1.00	2.10
	SDF1	We try to choose suppliers that are owned by minority ethnic groups/women	1.00	0.00	0.00				

Sustainable supplier selection

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Table 1.
Measurement model results

(continued)

Constructs	Code	Item wording	S.L	S.E	t-value ^{1,2}	A	C.R	AVE ³	VIF
Supplier's environmental focus (SEF)		Please indicate your choice on a scale 1 = Strongly disagree to 7 = Strongly agree				0.83	0.88	0.66	2.30
	SEF1	We try to choose suppliers whose processes/products are environmentally safe	0.91	0.01	65.9				
	SEF2	We try to choose suppliers that use recyclable/reusable packaging	0.94	0.01	87.92				
	SEF3	We try to choose suppliers who participate in green purchasing initiative	0.56	0.07	8.18				
Supplier's ethical treatment (SET)	SEF4	We try to choose suppliers that create as little waste as possible	0.79	0.04	19.18				
		Please indicate your choice on a scale 1 = Strongly disagree to 7 = Strongly agree				0.87	0.91	0.72	2.41
	SET1	We avoid tactics that could mislead supplier salespeople during negotiations	0.82	0.03	23.65				
	SET2	We never lie or exaggerate when negotiating with suppliers	0.89	0.02	58.39				
Supplier's human rights focus (SHR)	SET3	We avoid blaming suppliers for mistakes that were our own fault	0.86	0.02	43.38				
	SET4	We avoid using terms in our supply contracts that would allow us to take unfair advantage of suppliers	0.82	0.03	29.53				
		Please indicate your choice on a scale 1 = Strongly disagree to 7 = Strongly agree				0.92	0.94	0.81	3.50
	SHR1	We try to choose suppliers that do not use sweatshop labor	0.89	0.02	42.52				
SHR2	We try to choose suppliers that do not use child labor	0.90	0.02	51.25					
SHR3	We try to choose suppliers that pay their employees a fair wage to live on	0.93	0.01	84.46					
SHR4	We try to choose suppliers that support human rights	0.87	0.02	40.63					

Table 1.

(continued)

Constructs	Code	Item wording	S.L	S.E	t-value ^{1,2}	A	C.R	AVE ³	VIF
Supplier's community focus (FCF)		Please indicate your choice on a scale 1 = Strongly disagree to 7 = Strongly agree				0.93	0.95	0.82	3.03
	FCF1	We try help our local economy by choosing local suppliers whenever possible	0.84	0.04	19.79				
	FCF2	We value social programs sponsored by our suppliers	0.93	0.01	80.67				
	FCF3	We value awareness of social issues by our suppliers	0.94	0.01	112.87				
	FCF4	Providing an opportunity for other local businesses to succeed is important to the success of our company	0.91	0.01	73.70				
Supplier's safety focus (SSF)		Please indicate your choice on a scale 1 = Strongly disagree to 7 = Strongly agree				0.85	0.93	0.87	2.65
	SSF1	We try to choose suppliers that operate a safe work environment	0.93	0.02	56.42				
	SSF2	We try to choose suppliers that move and deliver good safety	0.93	0.01	65.06				
Financial performance (FP)		Compared to other companies that do the same kind of work as yours, how does your company compare over the last 3 years on (please indicate your choice on a scale 1 = much worse to 7 = much better)				0.88	0.93	0.81	1.50
	FP1	Sales revenues	0.90	0.02	55.24				
	FP2	Sales growth	0.90	0.02	37.56				
Firm's age	FP3	Market share	0.90	0.01	64.75				
	Age	How long has your organization been established? (1. 10 or less; 2. 11–50; 3. 50 or more)	1.00	0.00	0.00	1.00	1.00	1.00	1.15
Firm's size	Size	What is your company size (employees)? (1. 100 or less; 2. 101–1,000; 3. 1,001–10,000; 4. 10,001+)	1.00	0.00	0.00	1.00	1.00	1.00	1.10

*(continued)***Table 1.**

Constructs	Code	Item wording	S.L	S.E	<i>t</i> -value ^{1,2}	A	C.R	AVE ³	VIF
Annual revenue	Revenue	How large is your organization (annual revenues)? (1. \$0 to \$250M; 2. \$250 to \$500M; 3. \$500M to \$1B; 4. \$1B to \$3B; 5. \$3B+)	1.00	0.00	0.00	1.00	1.00	1.00	1.01
Industry type	Industry	Which category best describes your organization's primary industry? (1. Supplier; 2. Manufacturer; 3. Distributor; 4. Retailer; 5. Transportation; 6. Mineral Resource; 7. Other)	1.00	0.00	0.00	1.00	1.00	1.00	1.07
Ownership	Ownership	Please indicate the ownership structure of your organization. (1. Private; 2. Public; 3. Joint -Public/Private)	1.00	0.00	0.00	1.00	1.00	1.00	1.09

Note(s): 'B' stands for Baht, the name of Thai currency. 1 baht = 32 \$US

S.L = Standard loadings; S.E = Standard error; ¹Test-statistics are obtained by 5,000 Bootstrap runs;

² Absolute *t*-values > 1.96 are two-tailed significant at 5%; α = Cronbach's alpha; C.R = Composite reliability;

AVE = Average variance extracted; ³Percentage of variance of item explained by the latent variable; VIF = Variance inflation factor

Table 1.

loadings of 0.80 (Fornell and Larcker, 1981), while loadings 0.50 or greater are considered practically significantly for exploratory research (Nunnally, 1978). In Table 1, the standardized factor loadings for each measurement item are provided. The *t*-test of all the loadings is at the $p < 0.001$ level. All the loadings are above this minimum. The reliability and convergent validity of the constructs are evaluated by analyzing the Cronbach's alpha and composite reliability of the indicator. Nunnally (1978) recommends a value of 0.80 as a threshold value for this indicator. The Cronbach's alpha scores ranged between 0.654 and 0.865, while the composite reliability scores ranged between 0.76 and 0.93, indicating adequate convergence or internal consistency. Table 2 shows the means, SD, minimum and maximum values of the response option of the scales, the correlation for all the constructs and the square root of the AVE on the diagonals. Mean values indicate that most constructs are above their respective mid-point, while correlations among the independent constructs are relatively low. Thus, multicollinearity was not a concern in this study (Hair *et al.*, 2010).

4.2 Validity analysis

The average variance extracted (AVE) provides an assessment of convergent validity. Fornell and Larcker (1981) recommend an AVE value ≥ 0.5 . This means that 50% or more of the indicator variance should be accounted for. Consistent with this suggestion, all the constructs have an AVE value above this minimum as shown in Table 1. This study follows three approaches to assess the discriminant validity, that is: (1) Fornell-Larcker criterion, (2) cross-loading and (3) the heterotrait-monotrait ratio of correlations (HTMT). The correlation matrix in Table 2 shows that for each pair of constructs, the AVE square root of each construct (see Table 2 values on the diagonal) is higher than the absolute value of their

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. SDF	5.27	1.18	1.00	0.43	0.41	0.71	0.53	0.36	0.61	0.49	0.33	0.07	0.05	0.09	0.04	0.11
2. SEF	5.56	1.14	0.53	0.87	0.71	0.65	0.66	0.69	0.77	0.66	0.76	0.22	0.18	0.04	0.06	0.09
3. SET	5.74	0.95	0.37	0.66	0.85	0.61	0.64	0.52	0.69	0.71	0.73	0.24	0.18	0.03	0.05	0.10
4. SHR	5.68	1.14	0.78	0.69	0.48	0.90	0.72	0.64	0.83	0.79	0.56	0.22	0.07	0.07	0.05	0.06
5. SCF	5.71	1.16	0.57	0.73	0.55	0.72	0.92	0.71	0.86	0.82	0.63	0.22	0.17	0.07	0.09	0.05
6. SSF	5.48	1.19	0.50	0.70	0.53	0.59	0.73	0.93	0.80	0.75	0.71	0.30	0.14	0.05	0.02	0.05
7. SSS	5.81	1.11	0.71	0.72	0.49	0.79	0.76	0.79	0.88	0.64	0.71	0.30	0.11	0.06	0.06	0.04
8. RI	5.60	1.15	0.62	0.74	0.59	0.70	0.78	0.76	0.77	0.88	0.47	0.21	0.17	0.07	0.09	0.07
9. FP	5.80	1.07	0.34	0.71	0.75	0.48	0.53	0.58	0.56	0.55	0.90	0.35	0.18	0.09	0.11	0.17
10. Age	1.92	0.46	0.02	0.08	0.06	0.08	0.13	0.08	0.05	0.14	0.15	1.00	0.03	0.05	0.15	0.08
11. Size	4.30	14.01	-0.06	0.12	0.06	0.00	0.11	0.08	0.09	0.11	0.07	0.05	1.00	0.01	0.09	0.26
12. Revenue	5.66	17.60	-0.1	-0.17	-0.16	-0.18	-0.32	-0.18	-0.25	-0.23	-0.14	0.05	-0.03	1.00	0.02	0.03
13. Industry	2.43	1.30	-0.03	0.05	0.01	-0.07	0	-0.04	-0.07	-0.05	0.02	0.12	0.05	-0.06	1.00	0.08
14. Ownership	5.35	18.75	-0.06	0.06	0.1	-0.02	0.05	0.03	0.05	0.07	0.17	-0.05	0.27	-0.04	0.08	1.00

Note(s): SEF: Supplier's environmental focus; SET: Supplier's ethical treatment; SDF: Supplier's diversity focus; SHF: Supplier's human rights focus; SSF: Supplier's safety focus; SCF: Supplier's community focus; FP: Financial performance; RI: Resource investment; SSS: Sustainable supplier selection
Correlations are significant at the 0.01 level (2-tailed); *M* = Mean; *SD* = Standard deviation, diagonal and italicized elements are the square roots of the AVE (average variance extracted); below the diagonal elements are the correlations between the constructs values; Above the diagonal elements are the HTMT values

Table 2.
Descriptive statistics,
correlations, square
root of AVE and
HTMT analysis results

correlation (Fornell and Larcker, 1981). The results of cross-loading indicate that all items loaded higher on their respective constructs than on the other constructs and the cross-loading differences are much greater than the suggested threshold of 0.1 (Gefen and Straub, 2005). In all cases, the HTMT values are below the threshold of 0.85 or 0.90 as shown in Table 2. These results confirm that the discriminant validity is present in this study.

4.3 Analysis of structural model

4.3.1 Evaluation of the overall model predictability. This study follows Hair *et al.* (2017) to estimate the structural model using partial least squares based structural equation modeling (PLS-SEM) technique. This study assesses the structural model for collinearity. The results show minimal collinearity in the structural model as all variance inflation factor (VIF) values are far below the common cutoff threshold of 5–10 (Hair *et al.*, 2017). The structural model predictability is computed using variance explained R^2 values for the dependent latent constructs. The R^2 values of SSS is 0.83, and for FP is 0.54, as shown in Table 3, which is a satisfactory level of predictability. Following Hair *et al.* (2017), the significance levels of the path coefficients were obtained using the bootstrapping procedure (with 5,000 bootstrap samples and 235 bootstrap cases, using individual sign changes). The analysis of path coefficients and levels of significance of all direct relationships shows that H3–H7 were accepted while H1 and H2 were not accepted, as shown in Table 3(a).

Finally, the blindfolding procedure was run to compute the model's predictive relevance. Table 3 provides the Q^2 values of all the dependent constructs which are considerably above zero, thus providing support for the model's predictive relevance. This study follows Henseler *et al.* (2014) and refers to the standardized root mean square residual (SRMR) as an index for overall model fit validation. Scholars consider values below 0.08 as favorable (Hu and Bentler, 1999) in this instance. While the model estimation with PLS-SEM reveals an SRMR value of 0.07 as shown in Table 3, which confirms the overall fit of PLS-SEM (Hair *et al.*, 2017; Henseler *et al.*, 2014).

4.4 Analysis of moderating effect

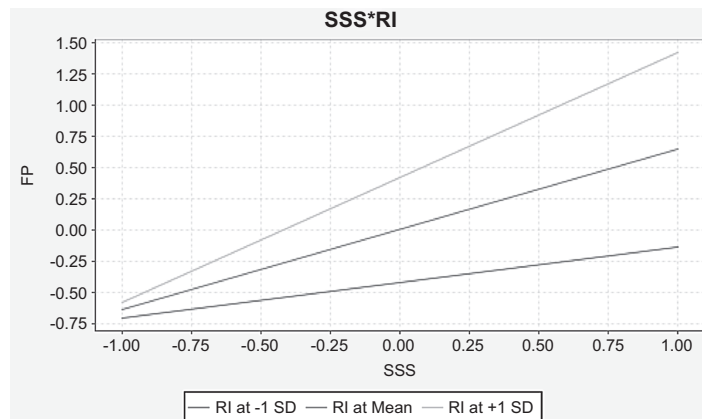
This study employed a computational procedure in SPSS using the PROCESS macro developed by Hayes (2013), to test for moderation (H8). This procedure not only implements moderation or mediation analysis, but also combines both to determine the significance of the interaction effects at different values of the moderator in an integrated moderated mediation model (Hayes, 2013). This study used PLS latent variables scores in PROCESS for moderation analysis. The moderating effect of RI on the indirect relationships between PSR and FP via SSS was statistically significant ($\beta = 0.35$, $t = 7.55$), in support of H8.

Table 3(b) shows that RI moderates the relationship between SSS and FP which necessitates examining the effect of SSS on FP with changes in RI. Next, this study examined RI at three levels to determine if the indirect relationships associated with SSS varied at different levels of RI. In other words, a simple slope analysis is used to estimate the effect on the main variable (SSS) at the moderate ($M = 5.60$, $S.D = 1.15$) one SD below the mean (-1 S.D; i.e. 4.45) and one SD above the mean ($+1$ S.D; 6.75) levels of the moderator, RI (Hayes, 2013). All variables were mean-centered before analysis. Consistent with H8, Table 3(c) shows that when RI was low (-1 S.D), the conditional indirect effect (via SSS) of PSR on FP was positive and significant but weak ($\beta = 0.29$, boot SE = 0.07). However, when RI was high ($+1$ S.D), the conditional indirect effect was both positive and significant ($\beta = 0.99$, boot SE = 0.09). These findings support the notion of the H8, which means as the influence of the mediating role of SSS increases, the effect of RI increases even to a more considerable extent. As shown in Figure 2, the relationship between SSS and financial performance is lower when RI is low, and stronger when RI is high.

Hypothesis	Relationship	Path coefficient	S.E.	t-value	Bootstrap 95% confidence interval	Conclusion
(a) Direct relationship						
H1	SEF → SSS	0.01 n.s.	0.06	0.23	(-0.11, 0.13)	Not supported
H2	SET → SSS	0.01 n.s.	0.05	0.23	(-0.09, 0.11)	Not supported
H3	SDF → SSS	0.16***	0.05	3.28	(0.06, 0.26)	Supported
H4	SHR → SSS	0.31***	0.07	4.60	(0.17, 0.45)	Supported
H5	SSF → SSS	0.29***	0.06	5.03	(0.17, 0.41)	Supported
H6	SCF → SSS	0.26***	0.06	4.29	(0.06, 0.26)	Supported
H7	SSS → FP	0.36***	0.12	2.91	(0.06, 0.26)	Supported
(b) Moderating effect						
Hypothesis	Outcome	Interaction	Path coefficient	S.E.	t-value	Bootstrap 95% confidence interval
H8	FP	Constant	-0.27	0.06	-4.95	(-0.38, -0.16)
		SSS	0.40	0.06	6.86	(0.28, 0.51)
		RI	0.64	0.07	9.83	(0.51, 0.77)
		SSS×RI	0.35	0.05	7.55	(0.26, 0.44)
(c) Conditional indirect effect (via SSS) of PSR on FP at different levels of RI						
Moderator	Effect	SE	t-value			Conclusion
Low; -1.0022 SD (RI)	0.29	0.07	4.01	Bootstrap 95% confidence interval		Supported
Moderate; 0.0000 Mean (RI)	0.64	0.06	9.83	(0.15, 0.43)		
High; + 1.0022 SD (RI)	0.99	0.09	11.35	(0.51, 0.77)		
(d) Non-hypothesized relationships						
Control variables paths	Effect	SE	t-value	Bootstrap 95% confidence interval		
Age → FP	0.03 n.s.	0.05	0.62	(-0.07, 0.14)		
Size → FP	-0.06 n.s.	-0.06	-0.91	(-0.20, 0.07)		
Revenue → FP	0.04 n.s.	0.03	1.09	(-0.03, 0.10)		
Industry → FP	0.05 n.s.	0.05	1.03	(-0.04, 0.14)		
Ownership → FP	0.14**	0.05	2.66	(0.04, 0.24)		
SRMR composite model = 0.07						
R ² SSS = 0.83; Q2 SSS = 0.57						
R ² FP = 0.54; Q2 FP = 0.40						
Note(s): SEF: Supplier's ethical treatment; SDF: Supplier's diversity focus; SHF: Supplier's human rights focus; SSF: Supplier's safety focus; SCF: Supplier's community focus; FP: Financial performance; RI: Resource investment; SSS: Sustainable supplier selection						
t ≥ 1.65 at p 0.05 level; ** t ≥ 2.33 at p 0.01 level; *** t ≥ 3.09 at p 0.001 level; n.s. = Not significant (based on t(4,999), one-tailed test)						
R ² = Determination coefficients; Q ² = Predictive relevance of endogenous (omission distance = 7).						
Threshold for R ² ≥ 0.25 (weak); ≥0.50 (moderate); ≥0.75 (substantial); Threshold for Q ² > 0 indicate predictive relevance						

Table 3.
Results for direct
relationships,
moderating and
conditional effects

Figure 2.
Moderating effect of RI
on the relationship
between SSS and FP
(see online version for
colors)



5. Conclusion and research implications

The SSS is a legitimate concern for the businesses while dealing with off-shore suppliers from the world's emerging economies, for example, Asia. Building on stakeholder theory, the current study examines the issue by analyzing the pressures from stakeholders' perspective as primary constituencies of the firm determining the extent to which firms consider social, ecological and economic aspects in the selection of emerging economy suppliers. Based on the data from one of the emerging markets in Asia, the results can be considered as indicative, rather than representative, of Asian supply chains. Based on the analysis of research model, all the eight hypothesized paths except two (suppliers' environmental focus and ethical treatment) were substantiated. These results are slightly different from earlier studies in the developed economies (Thornton *et al.*, 2013; Mishra and Suar, 2010; Carter *et al.*, 1999), where all of these paths were supported. Interestingly, we also found that firms' sustainable supplier selection practices are positively and significantly linked with superior financial performance. Also, the moderating effect of resource investment in sustainability initiatives was found to be significant.

The hypothesized paths that were not supported are H1 and H2: environmental focus and ethical treatment. This might be due to two features of selecting sustainable suppliers. First, anecdotal evidence suggests Thailand as an emerging economy is in the early stage of SSS adoption process. Companies seek short-term profits, while in later stages, companies might seek competitive advantage by adopting such practices. From the managerial perspective, our results suggest that the adoption of SSS is a multidimensional and gradual process rather than a static bundle of policies and practices related to choosing the right suppliers at a specific time. Second, Thailand is an emerging economy where environmental and ethical issues might have a lower priority than other PSR dimensions. However, awareness of the importance of the environmental and ethical treatment is growing.

In line with the stakeholder theory to achieve a combined result from which all the parties can benefit and take responsibility by pursuing the sustainability values of top management, a common desire to mitigate risk and stakeholder management are salient motivators for SSS adoption. Conversely, a lack of supplier awareness, negative perceptions and inadequate management support emerged as barriers to SSS implementation. This commitment to SSS through a cohesive and participative management in Thailand of all the relevant stakeholders can be benefited from the perspective of the theory of stakeholders. Many companies in Thailand are doing business with large MNCs and are increasingly under pressures from stakeholders (i.e. consumers, local government, global partners/alliances and

competitors). This motivates companies to adopt social and environmental practices to conform to global standards (Ansari *et al.*, 2010). This tendency is aligned with stakeholder theory, which postulated that businesses in emerging economies tend to adopt SSS to survive by reacting to external pressures, rather than proactively embedding SSS in their long-term business strategy and goals.

Finally, this study contributes to the sustainable supply chain management literature in three ways. First, a set of measurement scales for SSS has been adapted from the study by Carter and Jennings (2004) and applied with certain modifications. Second, this study theoretically establishes the link between Carter and Jennings's (2004) PSR variables and SSS, as well as empirically testing their relationships. Third, in earlier studies, Wu and Pagell (2011) found a positive relationship between a firm's sustainable business initiatives and its financial performance in the context of a mature economy. The present study was conducted within an emerging economy context that is culturally and economically different. Rettab *et al.* (2009) argue that socially and environmentally responsible business practices in emerging economies have little or no significance. Surprisingly, the findings of this study are counterintuitive, suggesting SSS and financial performance are also positively and significantly linked within the context of emerging economies.

This finding implies that by adopting SSS in emerging economies, MNCs and local firms can create a source of differentiation, and hence competitive advantage. Suppliers who do business with MNCs and are pursuing SSS can maintain and enhance their reputation as a qualifier and be a lucrative partner to do business with. This is in line with Porter and Kramer's (2006) argument, and it is through initiatives such as sustainable business practices that a company will have the most significant social impact and reap the greatest business benefits. Finally, building on SSS mechanism and drawing on stakeholder theory, current study adds to the existing body of literature by proactively engaging and communicating with key stakeholders, and having traceability and visibility into upstream supply chain operations can lead to superior financial performance.

Finally, the findings of this study have got macroeconomic implications in line with the sustainable development goals envisioned by the United Nations for the year 2030. Through adoption of SSS, business would be able to implement responsible production and consumption. This will enable to substantially change toward responsible management throughout the supply chain. SSS is expected to encourage companies, especially large and transnational companies operating in emerging economies, to adopt sustainable practices and to integrate sustainability information into their reporting system. Eventually, SSS will promote public procurement practices in emerging economies that are sustainable, in accordance with national policies and priorities, relevant information and awareness for sustainable development and lifestyles in harmony with nature.

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A study of the influence of workplace ostracism on employees' performance: moderating effect of perceived organizational support

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Influence of
workplace
ostracism

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Received 11 September 2019
Revised 31 January 2020
16 April 2020
23 April 2020
Accepted 7 May 2020

Abstract

Purpose – Based on the conservation of resource theory, this study developed and tested the relationship between workplace ostracism and job performance. And it assumes that the direct link between workplace ostracism and supervisor-rated in-role performance/organizational citizenship behavior is moderated by perceived organizational support.

Design/methodology/approach – For this, this study used a survey method and multiple regression analyses with multisource data from 256 Korean employees and their supervisors.

Findings – The results suggest the following. First, workplace ostracism was negatively associated with supervisor-rated in-role performance and organizational citizenship behaviors. Second, there was a stronger negative relationship between workplace ostracism and supervisor-rated in-role performance/organizational citizenship behaviors for employees with low as opposed to those with high levels of perceived organizational support.

Originality/value – This study is the first one to examine the moderating effect of perceived organizational support on the relationship between workplace ostracism and supervisor-rated in-role performance/organizational citizenship behavior.

Keywords Workplace ostracism, In-role performance, Organizational citizenship behavior, Perceived organizational support

Paper type Research paper

1. Introduction

Workplace ostracism, which is the extent to which people perceived as workers being ignored or eliminated by other employees at work, is a widespread workplace phenomenon, (Ferris *et al.*, 2008). Workplace ostracism decreases the opportunity for social interaction, which is essential for people to meet their psychological needs. Indeed, workplace ostracism potentially affects employees' physical health (Heaphy and Dutton, 2008). It is especially true today, as teamwork has dramatically increased, suggesting the need for more social interaction and communication with colleagues (Sundstrom *et al.*, 2000). According to a recent study, workplace ostracism is a very influential variable in explaining confined belonging and job contribution (O'Reilly and Robinson, 2009). Despite the prevalence and importance of workplace ostracism, surprisingly little research has examined the impact of this

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This study was supported by Sangmyung University 2019 Research Fund.



European Journal of Management
and Business Economics
Vol. 29 No. 3, 2020
pp. 333-345
Emerald Publishing Limited
e-ISSN: 2444-8494
p-ISSN: 2444-8451
DOI 10.1108/EJMBE-09-2019-0159

phenomenon (Ferris *et al.*, 2008). It is, therefore, essential and timely to understand the effect of employee retirement on employee outcomes. Ostracism is an interpersonal stressor that can cause psychological difficulties (Williams, 1997, 2001). Studies have shown that the pain experienced in the workplace is closely related to undesirable outcomes such as life distress, turnover intention and poor physical health (Grandey and Cropanzano, 1999). As a result, it is crucial to study the relationship between workplace ostracism and psychological pain in the workplace.

Moreover, it is also essential to understand how to cope with ostracism because effective coping strategies can alleviate the relationship between ostracism and its negative consequences (Williams, 2007). The conservation of resources (COR) theory assumes that people are trying to consume resources and maintain and protect the remaining resources in stressful situations (Hobfoll, 1989). According to this theoretical perspective, I conceptualize workplace ostracism as a stress factor that exhausts the worker's resources (e.g. self-esteem, time, energy) and makes the resources to meet labor demand insufficient. By examining the impact on employee attitudes, I extend the previous study showing the effect of job displacement on job outcomes. Also, I suggest that perceived organizational support (POS) is a vital variable in coping with workplace betrayal. The purpose of this study is, therefore, to investigate the relationship between workplace ostracism and employee attitudes by focusing on the joint moderating effect of POS.

This study makes two significant contributions to workplace ostracism, employee attitudes and POS-related literature. First, I extend the workplace ostracism and employee attitude literature by theoretically and empirically testing the ostracism model (Williams, 1997, 2001) to link workplace ostracism and job performance in a field setting. Second, I review the joint moderating role of coping strategies, providing boundary conditions for the relationship between workplace ostracism and job performance. I present the research model of this study in Figure 1.

2. Theoretical background and hypothesis development

Williams (1997; 2001) developed the most popular model for predicting the consequences of ostracism. This model is based on the belief that ostriches can be a threat to social resources and, consequently, stressors. Recent studies have shown that social ostracism leads to a series of psychological resistance reactions, including anger (Chow *et al.*, 2008) and negative mood (Gonsalkorale and Williams, 2007). In particular, organizational studies have shown that overtraining in the workplace is associated with high levels of anxiety, depression, job-seeking behavior and turnover intentions and low levels of satisfaction and psychological health (Ferris *et al.*, 2008; Hitlan *et al.*, 2006).

Interestingly, experimental studies provide evidence that the origin of ostracism does not significantly mitigate the harmful effects of ostriches. One study showed that people who were rejected by both inside and outside groups, manipulated by two groups of computer

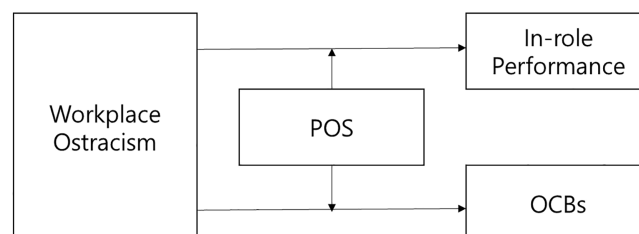


Figure 1.
Research model

users (PC and Macintosh users), experienced a similar level of belonging loss (Williams *et al.*, 2000). More research has revealed that rejection by contemptuous external group members is no more than being ostracized by rival out-group and in-group members (Gonsalkorale and Williams, 2007). Such distress includes job tension, emotional exhaustion and depressed mood at work. They have been linked to an outstanding job, family and health outcomes such as job satisfaction, work-family conflict (Grandey *et al.*, 2005), organizational citizenship behavior, workplace deviance (Lee and Allen, 2002), job performance (Cropanzano *et al.*, 2003), intention to leave (Harvey *et al.*, 2007) and high blood pressure (Schaubroeck and Merritt, 1997).

As interpersonal stressors, ostracism threatens the social resources of goals, which are assets that can be pulled to solve problems or cope with challenging events as needed (Greenhaus and Powell, 2006). People try to preserve, protect and establish resources in light of their limited resources (Hobfoll, 1989, 2001). Therefore, they see it as a threat when they see the potential or actual loss of these valuable resources. Indeed, resource loss events are responsible for most cases of depression (Hobfoll, 1989). Ostracism presents a significant challenge to reduce the resources an individual can have. It, on the one hand, requires individuals to mobilize resources to counter foreignism, while they are less likely to recharge their resources to others and cause resources to deplete. Because resources can help an individual deal with everyday tasks, people who lack resources can be stressed and tired.

Although both males and females may engage in ostracism, females' motivation is often retaliatory (e.g. self-defense), while male's violent behaviors tend to be control-motivated (e.g. restoration of power and dominance; Kimmel, 2002). For instance, the Philippine National Demographic and Health Survey reported that violence initiated by a married female is more common among those who have been battered by their spouse (Philippine Statistics Authority and ICF International, 2014). Despite the apparent gender symmetry in the prevalence of ostracism, females still suffer far more harmful effects. First, females as opposed to males experience more significant psychological distress and risk for posttraumatic stress disorder from partner-initiated aggression (Archer, 2000). Furthermore, gender differences in body size and physical strength make females, as opposed to males, more susceptible to severe injuries requiring sustained medical care and attention. Second, throughout the lifetime, a female is more likely to report repeated and multiple forms of abuse and suffer more severe injuries as a result (Sacket and Saunders, 1999). Thus, females have become the priority in violence prevention and control as they suffer more frequent and severe injuries than male (Saunders, 2002). Finally, females in many societies confront more career barriers and nonwork demands (e.g. glass ceiling effects and conflicting demands of multiple role obligations; Hoobler *et al.*, 2009) than males. Therefore, the results of ostracism on female employees may be particularly damaging. For these reasons, I focus on the work-related consequences of ostracism among employed females.

I suggest that resource loss due to experience with workplace ostracism can lead to workplaces that directly affect job performance. Workplace ostracism also results in a more indirect "loss spiral," leading to subsequent losses in other areas (Hobfoll, 2001; Ten Brummelhuis and Bakker, 2012) by depriving resources in one area. For example, workplace ostracism can lead to depletion of cognitive and physical energy as the negative perceptions and emotions of the family domain persist in the workplace. Employees must consume psychological resources to contain these negative thoughts and feelings if they do not want to undermine performance. Sadly, psychological interference with excretion in the workplace has been shown to reduce mental concentration, which is not always easy, as it can be detrimental to work productivity. I propose the following.

- H1. Workplace ostracism of female employees is negatively related to their in-role performance

Loss of resources experienced at home can reduce performance aspects other than the employee's prescribed job role. These aspects include organizational citizenship behaviors (OCBs) or voluntary and altruistic actions performed at work (Horton and Johnson, 1993). It is reasonable to assume that employees whose cognitive and emotional resources are depleted by workplace rejection are more likely to use available resources to meet their role requirements. As a result, the number of resources available to perform additional role actions can be significantly reduced. This possibility is consistent with the conservation principles of the COR theory, and individuals are motivated to preserve and reclaim lost resources fundamentally, thereby avoiding actions that could result in the loss of more resources. Also, even if women have excess resources, women can devote their lives to activities that help them deal with trauma from workplace excretion. For example, an employee who has experienced a work-out without having to spend time volunteering with an organizational committee instead of helping a coworker can decide to spend time and effort on remediation or take legal action against the partner. Sacrificing OCBs to deal with workplace ostracism-related concerns is economically rational because the failure to exhibit such behaviors is generally not punished by organizations (Podsakoff *et al.*, 2000). I propose the following.

H2. Workplace ostracism of female employees is negatively related to their OCBs

The COR theory predicts that people will invest or draw in other resources that they own or have access to in their environment to reduce the net loss of their resources. In an elaborate description of the COR theory, Ten Brummelhuis and Bakker (2012) suggested that in addition to their pool of resources, the environment in which people live can serve as a resource for buffering. One workspace resource that appears to buffer stressors constraints is recognized as POS (organizational support). According to the organization support theory (OST), employees must formulate support expectations based on how much an organization contributes and how well they are concerned about employee well-being (Eisenberger *et al.*, 1986).

According to the OST, I expect POS to cushion the negative relationship between job displacement and job outcomes for several reasons. First, POS provides access to the relevant resources of the workplace, which can help abused women supplement or stockpile resources. For example, support in the form of organizational policies such as personal leave and flexible work placement can provide opportunities for women to get out of work and get out of the workplace. (Allen, 2001). Supportive work environments can also help reduce work demands that can help peers to take over the work assigned to them and preserve the remaining resources (Ray and Miller, 1994). Second, a supportive work environment signals that the employee is a valued member of the organization, which can lead to resource accumulation through its positive impact on one's sense of self-worth and its satisfaction of the fundamental human need for belongingness (Rhoades and Eisenberger, 2002). Feeling of self-esteem and belonging are both essential social and emotional resources so that events or experiences that supplement or increase them can potentially respond to resource demands coping with job exclusion. Based on this theoretical argument, I provide the following predictions.

H3. The negative relationship between workplace ostracism of female employees and their in-role performance is moderated by their POS, such that the negative relation is stronger for low as opposed to high levels of their POS.

H4. The negative relationship between workplace ostracism of female employees and their OCB is moderated by their POS, such that the negative relation is stronger for low as opposed to high levels of their POS.

3. Methodology

3.1 Data collection and sample

The objective of the study is to identify behavioral factors related to workplace ostracism by an empirical test. The elements of organizational behaviors can be identified by measuring female employees' perceptions in the workplace situations. I adopted an online survey method using convenience sampling for data collection as it is instrumental in collecting data from a large number of individuals in a relatively short time and at a better cost.

I conducted a survey of 500 employees who worked full time in various occupations in eight organizations, including manufacturing ($n = 3$), public agency ($n = 2$) and wholesale and retail ($n = 3$). I got the email addresses of the employees through the human resources management department. All participants received an email explaining the purpose of the survey, emphasizing voluntary participation, and asking for an online survey, along with an email in confidence. Participants were also given a simple questionnaire to help their direct supervisor complete the questionnaire, including questions about the participants' work behavior.

To match the employee survey with the supervisor survey, participants created a unique code identifier to display the first two letters of the mother's name, the last two letters of the father's name and the year of birth. All surveys were returned directly to the research team via email. Upon completion of the survey, the employee participant received a coffee voucher as a token to participate in the study. Of the initial pool of participants surveyed, 280 individuals returned completed surveys, yielding a response rate of 56%. Also, 248 supervisor questionnaires were returned, representing a response rate of 49.6%. After the deletion of surveys with (1) no code identifiers, (2) an excessive number of missing cases and (3) without a matched supervisor questionnaire, I was left with a final sample of 226 matched supervisor-subordinate dyads. The characteristics of respondents are reported in Table 1 (e.g. age, the level of their education, the marital status).

Variables	Items	Percentages
Age	20s	24.6
	30s	27.4
	40s	22.4
	50s	25.6
Tenure	Less than 5 years	53.3
	6–9 years	23.5
	10–14 years	12.3
	15–19 years	4.2
	More than 20 years	6.7
Level of their education	Middle school	0.7
	High school	15.8
	Community college	20.8
	Undergraduate school	52.9
	Graduate school	9.8
Position	Staff	44.6
	Assistant manager	18.2
	Manager	15.4
	Senior manager	13.3
	Director	6.3
	Etc	2.1
Marital status	Married	54.7
	Single	45.3

Table 1.
Sample profile

3.2 Measurement

Workplace ostracism. A ten-item scale developed by Ferris *et al.* (2008) was used to measure workplace ostracism. Response options ranged from 1 (“strongly disagree”) to 5 (“strongly agree”). Sample items included “Others ignored me at work,” “Others left the area when I entered,” and “My greetings have gone unanswered at work.” Cronbach’s alpha for this measure was 0.92.

In-role performance

Supervisors were asked to rate the in-role performance of their employees using four items derived from Williams and Anderson (1991). Example items include, “This employee meets formal requirements of her job” and “This employee adequately completes assigned duties.” In this sample, coefficient alpha was 0.93.

Organizational citizenship behaviors

Supervisors were asked to rate the extent to which their employees engage in behaviors which are beneficial to both their organization and colleagues. I used a 20-item scale developed by Podsakoff *et al.* (2000). Example items include “This employee helps others who have heavy workloads” and “This employee willingly gives her time to help others who have work-related problems.” In this sample, Cronbach’s alpha was 0.91.

Perceived organizational support

POS was measured using eight items from the scale developed by Eisenberger *et al.* (2001). Sample items from the scale include “My organization cares for my well-being” and “Help is available from my organization when I have a problem.” In this sample, Cronbach’s alpha was 0.96.

4. Results

4.1 Verification of reliability and validity

The validity of variables is verified through the principal components method and factor analysis with the varimax method. The criterion for determining the number of factors is defined as a 1.0 Eigenvalue. This study applied the elements for analysis only if the factor loading was more significant than 0.5 (factor loading represents the correlation scale between a factor and other variables). The reliability of variables is judged by internal consistency, as assessed by Cronbach’s alpha. This study used surveys and regarded each as one measure only if their Cronbach’s alpha values were 0.7 or higher.

4.2 Relationship between variables

Table 2 summarizes the Pearson correlation test results between variables and reports the degree of multipropriety between independent variables. The minimum tolerance of 0.720

	1	2	3
Workplace ostracism	1		
In-role performance	-0.042**	1	
OCB	-0.032**	0.025*	1
POS	0.110	0.101**	0.061*

Table 2.
Variables’ correlation coefficient and other statistics

Note(s): * $p < 0.05$, ** $p < 0.0$

and the maximum variation coefficient of 1.388 indicate that the statistical significance of the data analysis has not been compromised by multiconnectivity.

4.3 Hypothesis test

I used three-step hierarchical multiple regression analyses to test the hypotheses. In the first step, demographic variables were controlled. Workplace ostracism of female employees was entered in the second step. In the final step, the multiplicative interaction terms between workplace ostracism of female employees and their POS were introduced to test the current hypothesis about the moderating effect directly. Regarding in-role performance, results are presented in Table 3. Hierarchical regression analysis showed that workplace ostracism of female employees ($\beta = -0.031, p < 0.01$) was negatively related to their in-role performance, meaning that the more workplace ostracism female employees perceived, they were likely to show less in-role performance. Therefore, H1 was supported. Table 3 also indicates that POS of female employees significantly moderated the relationships between their workplace ostracism and in-role performance in the predicted direction ($\beta = 0.054, p < 0.05$). This result demonstrated that the negative correlation between workplace ostracism of female employees and their in-role performance was stronger for female employees with low rather than high POS (see Figure 1). Therefore, H3 was supported.

Regarding their OCB, results are presented in Table 4. Hierarchical regression analysis showed that workplace ostracism of female employees ($\beta = -0.091, p < 0.01$) was negatively related to their OCB, meaning that the more workplace ostracism female employees perceived, they were likely to show less their OCB. Therefore, H2 was supported. Table 4 also indicates that POS of female employees significantly moderated the relationships between their workplace ostracism and OCB in the predicted direction ($\beta = -0.026, p < 0.05$). This

	In-role performance		
	Model 1	Model 2	Model 3
Age	0.012	0.024	0.019
Educational level	-0.052	-0.068	-0.071
Tenure	-0.119	-0.120	-0.101
Workplace ostracism		-0.031**	-0.024**
POS			0.011**
Workplace ostracism *POS			0.054*
Adj. R^2	0.005	0.119	0.125
F	1.227	10.075**	14.162**

Note(s): * $p < 0.05$, ** $p < 0.01$

Table 3. Analysis 1

	OCB		
	Model 1	Model 2	Model 3
Age	0.082	0.101	0.099
Educational level	0.017*	0.028*	0.022*
Tenure	0.033	0.042	0.065
Workplace ostracism		-0.091**	-0.087**
POS			0.045**
Workplace ostracism *POS			0.026*
Adj. R^2	0.006	0.129	0.145
F	1.338	12.881**	16.201**

Note(s): * $p < 0.05$, ** $p < 0.01$

Table 4. Analysis 2

result demonstrated that the negative relation between workplace ostracism of female employees and their OCB was stronger for their employees with low rather than high POS (see Figure 2). Therefore, H4 was supported.

5. Conclusion

5.1 Summary of research results

Prior work has established the negative relationship between workplace ostracism and work outcomes (Grandey *et al.*, 2005; Lee and Allen, 2002; Cropanzano *et al.*, 2003; Harvey *et al.*, 2007). However, this study not only focuses on the influence of workplace ostracism and both supervisor-rated in-role performance and OCB but also investigates how POS moderates the relationship between workplace ostracism and work outcomes, including in-role performance and OCB. The results of the present study are summarized as follows. First, the more employees suffer from workplace ostracism, they are less likely to show in-role performance and OCB. Second, POS decreases the influence of workplace ostracism work outcomes, including in-role performance or OCB. Employees with a higher level of POS can reduce work demands generated by workplace ostracism through access to relevant resources at work. And, employees with a higher level of POS decrease psychological demands that coping with workplace ostracism places on the employee through feeling their sense of self-worth and its satisfaction of the fundamental human need for belongingness.

5.2 Contributions and implications

The contribution of this paper is that it provides evidence that organizations, as potential resource supplements and accumulators, can mitigate the exclusive consequences of the workplace. This finding is consistent with previous empirical evidence supporting the beneficial role of support organizations in reducing the negative labor consequences of workers (Bagger and Li, 2014; Clark *et al.*, 2015). POS has protection because it requires instrumental, emotional and assessment support to cushion work-related needs. At the same time, POS protects nonwork stressors that affect their ability to perform effectively in the workplace and employees who experience job displacement from subsequent resource loss. Indeed, Hobfoll (2001) pointed out that individuals with more resources can regenerate their lost resources. Workshops are generally regarded as safe havens for women who experience partner aggression (Wettersten *et al.*, 2004). POS can thus reduce the impact of family-to-work conflicts when employees face multicultural stressors and can potentially contribute to important careers in job retention. Individuals utilize existing resources to create more resources (Hobfoll, 2001). The culture of working and family support positively affects employee commitment and career expectations in developed and emerging economies (Stock *et al.*, 2015; Chang *et al.*, 2014). In a similar vein, work is an important context in which resources can be obtained to restore an abusive and intimate relationship. Specifically, the ability to maintain employment is an important predictor of economic independence and self-reliance and predicts the end of recovery and abuse (Jewkes, 2002; Raghavan *et al.*, 2005). Therefore, occupational productivity and job entry opportunities are heavily influenced by the experience of leaving the workplace under low POS conditions as workers' exhaustion resources are conserved and replaced rather than reproduced.

Despite the widespread prevalence of workplace ostracism in the world, we rarely know how it interferes with work and life. This study is to make a real contribution to workplace ostracism and management literature. First, POS not only reduces the impact of families on labor conflicts, when faced with multicultural stress factors but also can potentially contribute to important responses to job maintenance (Ten Brummelhuis and Bakker, 2012). The results of two independent samples further reinforce our argument that the harmful

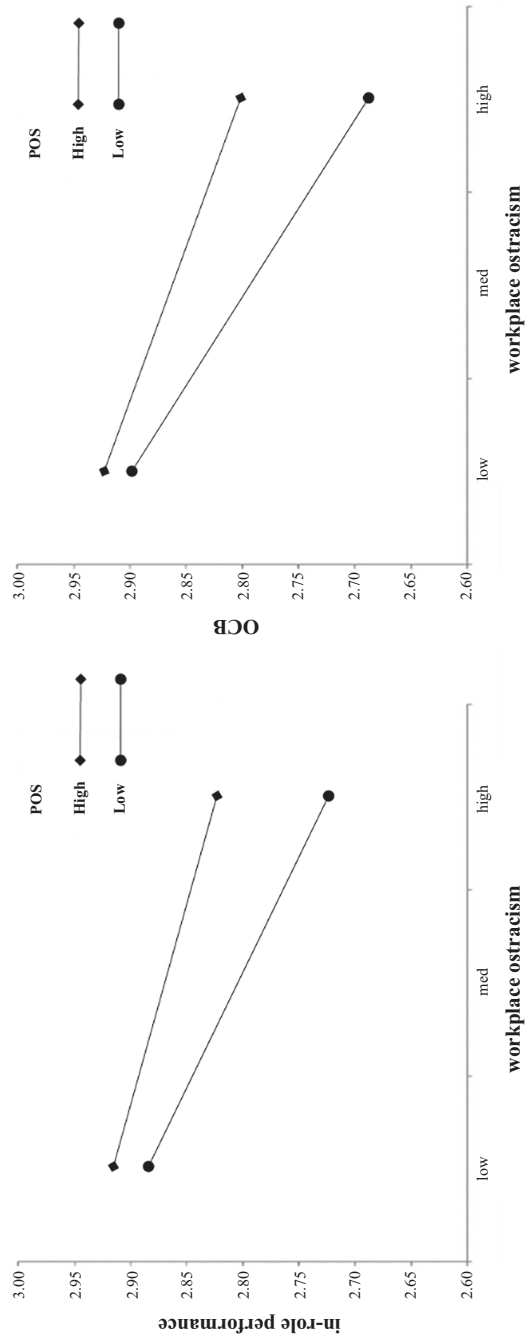


Figure 2. Interaction between workplace ostracism and POS on in-role performance and OCB

effects of workplace ostracism are no longer confined to the home context. The study also provides a theoretical foundation for understanding how certain workplace conditions, such as POS, act as contextual resources to buffer the adverse effects of workplace ostracism on work outcomes. The results support this controversy and provide a clear message about the organization's critical role in the practical management of workplace ostracism activities. I also identify POS assumptions that workplace support is most important when a critical event occurs, such as when an employee is leaving the job.

This study provides practical implications that are directly related to the performance management of vulnerable employees. One way an organization can prevent the negative consequences of rejection at work is to increase employee POS by promoting a supportive culture that delivers zero tolerance for domestic violence. POS has resulted in employees valuing the company's contributions and well-being, resulting in securing resources to provide the necessary rest for employees to overcome and cope with the experienced difficulties of exclusivity within the workplace (Allen, 2001; Eisenberger *et al.*, 1986; Wettersten *et al.*, 2004). Uncertain support human resource practices will be beneficial only if the organization is accompanied by a change in how they view workplace family issues such as ostracism (Kossek and Lobel, 1996). To effectively cultivate a supportive organizational culture, managers must support their work-life initiatives by enforcing policies and encouraging them to use support resources at work (Bardoel and De Cieri, 2014). For example, the pioneering work of Liz Claiborne, Inc. is a good example of how social problems such as domestic violence can be integrated into an organization's social responsibility initiative (O'Leary-Kelly *et al.*, 2008). An organizational culture that supports recognizing exclusivity in the workplace as an important social and workplace issue helps managers to respond more quickly to the needs of affected employees.

Consequently, awareness of the workplace as a haven can increase organizational support utilization, which can be an important aspect of terminating abusive relationships between employees by providing a pathway for economic self-sufficiency and independence (Horton and Johnson, 1993; Raghavan *et al.*, 2005). Employers can optimize the favorable location of managers and coworkers to detect risks and provide instant assistance to affected employees through daily face-to-face contact. One way an employer can create a positive and supportive culture for vulnerable employees is to allow managers and employees to educate them about how to react safely when sensitive family issues are interfering with their work, for example, access to risk, public administration, confidentiality, referral system and employee support programs. Attempting to respond to managers and colleagues without understanding the complex nature of out of work and the appropriate occupational health and safety procedures available at work is particularly important because it can harm others or themselves. For example, desirable supervisor support varies depending on the state of change of the staff, ranging from limited preferences to full acceptance of organizational support to ending violent relationships (Perrin *et al.*, 2011). Finally, given the sensitive nature of workplace exclusivism, affected employees must be able to use the employee support program confidently. To address fears associated with stigmatization, employers must state in their policies that the use of worker family support will not jeopardize job performance evaluations. From an employee's point of view, an increase in the perception that support is available and accessible in the workplace can lead to an act of seeking help to prevent an increase in exclusive cheating in the workplace (Duffy *et al.*, 2005). Flexible job preparation can also help to save resources, which can reduce work demands. Furthermore, workplace family support in the form of job sharing, as well as access to a safe and flexible workplace, increases psychological safety and protects employees affected by workplace accidents (Swanberg *et al.*, 2005). However, the existence of workers' family structures and formal support (e.g. employee support policies and programs) does not necessarily guarantee the use among employees who are most in need of stigmatization (Kwesiga *et al.*, 2007). Indeed,

women are less likely to use family support initiatives in organizations that implement formal management discretionary approaches (Kelly and Kalev, 2006). It may be because women are faced with great pressure to show a high commitment to work and to reduce interfamily labor. Therefore, supportive organizational culture is appropriate for employees who experience workplace ostracism, particularly to promote psychological safety at work.

5.3 Limitations and future research directions

Based on the results of this study, this study may have some insight into the relationship between workplace ostracism and the organizational behavior of employees. However, this study should acknowledge the following limitations. First, the survey collected responses from employees working in South Korean businesses. There may be some national cultural issues in the organizational context. Second, this study was measured as a variable at the same time, but I am not sure that the relationship is consistent. Although the survey questions are arranged in reverse order of the analytical model, causal problems between variables may exist. Third, this study focuses on the workplace ostracism of female employees. Therefore, this study has the limitation of generalizing to employee outcomes regarding workplace ostracism. Future research should examine other types of impact of dark leadership, such as workplace bullying and organizational politics on employee organizational behavior.

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Economic policy uncertainty and Bitcoin. Is Bitcoin a safe-haven asset?

Economic
Policy
Uncertainty
and Bitcoin

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Received 17 July 2019
 Revised 10 December 2019
 2 January 2020
 Accepted 11 January 2020

Abstract

Purpose – The goal of this work is to determine whether Bitcoin behaves as a safe-haven asset. In order to do so, the influence of Economic Policy Uncertainty (EPU) on Bitcoin returns and volatility was studied.

Design/methodology/approach – It is evaluated whether, when compared with the evolution of EPU, Bitcoin's returns and volatility show behaviours typical of safe havens or rather, those of conventional speculative assets. When faced with an increase in EPU, safe havens – such as gold – can be expected to increase their returns and volatility, while conventional speculative assets will increase their volatility and reduce their returns. This study uses simple linear regression and quantile regression models on a daily data sample from 19 July 2010 to 11 April 2019, to analyse the influence of EPU on the returns and volatility of Bitcoin and gold.

Findings – Bitcoin's returns and volatility increase during more uncertain times, just like gold, showing that Bitcoin acts not only as a means of exchange but also shows characteristics of investment assets, specifically of safe havens. These findings provide useful information to investors by allowing Bitcoin to be considered as a tool to protect savings in times of economic uncertainty and to diversify portfolios.

Originality/value – This study complements and expands current research by aiming to answer the question of whether Bitcoin is a simple speculative asset or a safe haven. The most significant contribution is to show that Bitcoin is not a mere speculative asset but behaves like a safe haven.

Keywords Bitcoin, Economic policy uncertainty, Safe-haven asset, Speculative asset

Paper type Research paper

1. Introduction

After the outbreak of the global financial crisis and the consequent loss of confidence in the existing financial system along with extreme uncertainty regarding economic policy measures that would be taken by governments and central banks, Nakamoto (2008) proposes an alternative to conventional fiduciary currencies by creating the “digital currency” Bitcoin.

Since Bitcoin was launched, its value has grown rapidly going from \$0.09 on 18 July 2010, to a historical high of \$19,870.6 on 17 December 2017. This rapid increase has motivated a growing interest in the literature to understand the economic and financial determinants that may influence Bitcoin's price (Demir *et al.*, 2018), since the behaviour of this virtual currency seems to be independent of economic and financial developments (Kristoufek, 2015; Polasik *et al.*, 2015). Several studies argue that in times of economic instability and low confidence in common economic and financial structures, the attractiveness of Bitcoin increases (Bouri *et al.*, 2017a; Luther and Salter, 2017; Demir *et al.*, 2018; Fang *et al.*, 2019). In this line, it has been argued that Bitcoin could act as a solution to the inefficiency of these structures by using it as a hedging instrument against the stock market (Dyhrberg, 2016; Bouri *et al.*, 2017a; Demir *et al.*, 2018; Selmi *et al.*, 2018; Guesmi *et al.*, 2019; Fang *et al.*, 2019).



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European Journal of Management
and Business Economics
Vol. 29 No. 3, 2020
pp. 347-363
Emerald Publishing Limited
e-ISSN: 2444-8494
p-ISSN: 2444-8451
DOI 10.1108/EJMBE-07-2019-0116

Although the possibility of Bitcoin acting as a hedging and safe-haven instrument against economic uncertainty has been suggested, Bitcoin is not exempt from criticism. Its speculative nature (Cheah and Fry, 2015; Baur *et al.*, 2018; Eom *et al.*, 2019), bubble formation tendencies (Cheah and Fry, 2015; Corbet *et al.*, 2018; Bouri *et al.*, 2019), high price volatility (Brandvold *et al.*, 2015; Eom *et al.*, 2019; Aalborg *et al.*, 2019) and the scandals and frauds that have accompanied it (Selmi *et al.*, 2018), have generated a debate regarding its suitability and role in the financial system. Is it a simple means of exchange and a store of value, a speculative asset or a safe haven?

Consequently, the purpose of our research is to study the role that Bitcoin plays when confronted with Economic Policy Uncertainty (EPU). Can it act as a hedge or safe haven in the face of economic uncertainty due to its independence from the existing economic and financial system or should it be considered as a speculative asset due to its high volatility? To achieve this, we study the influence of EPU on the returns and volatility of Bitcoin and gold, with EPU being understood as the “non-zero probability of changes in existing economic policies” (Baker *et al.*, 2016). This is one of the first studies that evaluates the role played by Bitcoin taking into account the return and volatility behaviour of this cryptocurrency in the face of variations in EPU. This approach to determine the role played by Bitcoin is adequate because (1) the influence of EPU on the volatility of Bitcoin allows us to determine whether this cryptocurrency can be considered as a simple means of exchange or as an investment asset and (2) the impact of EPU on the return of this cryptocurrency allows us to determine whether Bitcoin can be considered as a simple speculative asset or as a refuge value. It could be expected that when investors are faced with uncertainty regarding future fiscal, regulatory and monetary policies, hedges or safe-haven assets will increase their returns and volatility while typical speculative assets will increase their volatility but reduce their returns. Likewise, another important contribution of this study is the distinction of the influence of EPU in the return and volatility of Bitcoin by quantiles, being outstanding to know the behaviour of the return and volatility of Bitcoin against EPU in times of greater and lesser EPU.

By using the EPU measure of Baker *et al.* (2016) on the daily returns and volatility of Bitcoin and gold from 19 July 2010 to 11 April 2019, it was found that EPU has a positive impact on Bitcoin returns and volatility at higher quantiles, just like gold. These results demonstrate that Bitcoin does not act as a simple means of exchange, the main purpose for which it was created, but rather that it presents characteristics of investment assets, specifically of safe havens. These findings allow investors to consider this asset as a tool to protect their savings in times of economic uncertainty and build diversified portfolios including Bitcoin.

From here, the work is structured as follows:

In Section 2, we review the existing literature in our area of study. Section 3 lays forth the data used for our research. In Section 4, we discuss our methodological choices. Section 5 contains our results and leads into Section 6, where we examine and explain the conclusions of the study.

2. Literature review

Since its launch, Bitcoin has attracted the attention of professionals, academics and the media due to its exclusive decentralized payment system based on Blockchain technology (Wang *et al.*, 2018) and independency from sovereign governments, centralized institutions and banking systems (Fang *et al.*, 2019).

One of the issues that have generated the most interest is the understanding of Bitcoin price determinants. Thus, several studies have tried to explain and predict the price of Bitcoin, such as Kristoufek (2013) demonstrates that it is difficult to explain Bitcoin prices

using standard financial theory, and Aalborg *et al.* (2019) determined that the price of Bitcoin is unpredictable, even though its volatility can be predicted by its past values. This lack of understanding of the formation of Bitcoin prices has generated a debate around its role.

The fact that Bitcoin is a decentralized currency, independent of sovereign governments, centralized institutions and banking systems (Fang *et al.*, 2019) has suggested that Bitcoin may be part of an alternative economy (Bouri *et al.*, 2017b). In this way, it becomes possible for Bitcoin to act as an instrument for hedges or safe havens in the face of loss of confidence in the economic system. However, its speculative nature (Cheah and Fry, 2015; Baur *et al.*, 2018; Eom *et al.*, 2019), bubble formation tendencies (Cheah and Fry, 2015; Corbet *et al.*, 2018; Bouri *et al.*, 2019), high price volatility (Brandvold *et al.*, 2015; Eom *et al.*, 2019; Aalborg *et al.*, 2019) and the scandals and frauds that have accompanied it (Selmi *et al.*, 2018), create questions as to whether this asset can be considered a safe-haven asset. Is it acting as an exchange instrument or rather, as a simple speculative asset? In this line, several works have tried to explain its role by relating its behaviour to stocks (Bouri *et al.*, 2017b; Fang *et al.*, 2019), bonds (Bouri *et al.*, 2017b; Fang *et al.*, 2019), commodities (Bouri *et al.*, 2017b; Bouri *et al.*, 2018a; Selmi *et al.*, 2018; Shahzad *et al.*, 2019; Fang *et al.*, 2019), gold (Bouri *et al.*, 2017b; Bouri *et al.*, 2018a; Al-Khazali *et al.*, 2018; Selmi *et al.*, 2018; Shahzad *et al.*, 2019), conventional currencies (Bouri *et al.*, 2017b), financial stress (Bouri *et al.*, 2018b) and EPU (Bouri *et al.*, 2017a; Demir *et al.*, 2018; Selmi *et al.*, 2018; Wang *et al.*, 2018; Fang *et al.*, 2019).

The great recovery capacity of Bitcoin during periods of turbulence has suggested the possibility of this cryptocurrency acting as a hedging instrument and a safe haven against global uncertainty (Selmi *et al.*, 2018). According to Weber (2014), Bitcoin benefited from the uncertain economic environment that followed the 2008 crisis. During these periods of turbulence, many saw Bitcoin as a safe haven against the uncertainty surrounding conventional banking and economic systems (Bouri *et al.*, 2017a). In addition, its low transaction costs contributed to an increase in the demand for Bitcoins (Ciaian *et al.*, 2016).

Based on the above proposition, an emerging area of the literature investigates the possible relationship between the behaviour of Bitcoin and economic uncertainty to justify its possible function as a safe haven. Bouri *et al.* (2017a) examined whether Bitcoin could hedge global uncertainty, measured by the first principal component of the Volatility Indices (VIX) of 14 developed and developing equity markets, finding that Bitcoin acts as a diversifier, a hedge or a safe haven against uncertainty. Al-Khazali *et al.* (2018) analysed the impact of positive and negative macroeconomic news surprises on gold and Bitcoin, finding that, although gold reacted systematically to such surprises in a consistent way with its role as a safe-haven asset, Bitcoin did not react in a similar way. Selmi *et al.* (2018) evaluated the role of Bitcoin as a safe haven, a hedge and/or a diversifier for extreme oil price movements, compared to gold. They show how both Bitcoin and gold fulfil the functions of a safe haven and diversifier for oil price movements, concluding that both Bitcoin and gold are assets in which investors can deposit their cash during moments of political and economic turmoil. Demir *et al.* (2018) use the EPU measure of Baker *et al.* (2016) to predict Bitcoin returns. The document finds that EPU has a predictive power on Bitcoin returns, finding an overall negative effect. However, when differentiating by quantiles, they discover that the effect is positive and significant at the lowest and highest quantiles, concluding that Bitcoin can serve as a hedge against uncertainty. Wang *et al.* (2018) investigated the effect of the risk derived from EPU on Bitcoin, proposing that if Bitcoin is independent of the existing economic and financial system, EPU would not affect it. By using the EPU index and the Equity Market Uncertainty index of Baker *et al.* (2016), as well as the VIX as proxies of EPU, they find that the risk spillover effect from EPU to Bitcoin is insignificant and, therefore, Bitcoin could act as a safe haven or diversifier of EPU. Fang *et al.* (2019) analysed the influence of EPU on the long-term

volatility of Bitcoin, global stocks, commodities and bonds, finding that EPU influenced the volatility of Bitcoin, stocks and commodities, but not bonds. At the same time, they discovered that EPU has a significant negative impact on the Bitcoin–Bonds correlation, and a positive impact on the Bitcoin–stocks and Bitcoin–commodities correlations, which leads to suggesting the possibility of Bitcoin to act as a hedge under specific economic uncertainty conditions. However, they determine that the effect found is weak.

Meanwhile, an alternative line of research defends a more speculative role for this cryptocurrency. Bitcoin price booms and crashes motivated Cheah and Fry (2015) to study whether Bitcoin could be developing speculative bubbles, finding that Bitcoin prices contain a substantial speculative bubble component (Dowd, 2014), and that the fundamental value of this cryptocurrency is zero. Other authors investigating the possible existence of speculative bubbles in the formation of Bitcoin prices are Corbet *et al.* (2018). Using as underlying fundamentals of the Bitcoin price, the blockchain position, the hash rate and liquidity as measured by the volume of daily transactions, they find that Bitcoin goes through some bubble periods. Bouri *et al.* (2019) studied the explosiveness of Bitcoin prices and identify the formation of speculative bubbles in this cryptocurrency. In turn, the volatility of this cryptocurrency has been criticized. In their study on the discovery of Bitcoin prices, Brandvold *et al.* (2015) showed the high temporal volatility of this cryptocurrency. Similarly, Eom *et al.* (2019) find that investor sentiment shows a significant power of explanation for changes in Bitcoin volatility, concluding that Bitcoin seems to be an investment asset with high volatility and dependence on sentiments rather than a medium of exchange. These same authors suggest that these findings support the literature that finds that Bitcoin has characteristics of speculative assets. Another study that defends the role of Bitcoin as a speculative asset is that of Baur *et al.* (2018). These authors analyse whether Bitcoin is a medium of exchange or a speculative asset, showing how Bitcoin is used mainly as a speculative investment and not as a simple medium of exchange.

Based on the above proposition, the aim of our research is to study whether Bitcoin acts as a means of exchange, a safe-haven value or refuge or a speculative asset.

3. Data

To study the influence of EPU on the returns and volatility of Bitcoin and gold, we extracted daily data of EPU, Bitcoin and gold for the period spanning from 19 July 2019 to 11 April 2019.

As a measure of EPU, we chose the daily US EPU index based on Baker *et al.* (2016) (<http://www.policyuncertainty.com>). This index is constructed based on the number of newspaper articles in the US that contain, at least, the following combination of terms: “economy” or “economic”; “uncertain” or “uncertainty” and “legislation”, “deficit”, “regulation”, “Congress”, “Federal Reserve” or “White House”.

Figure 1 shows the evolution of EPU for the period that is under study. We find that EPU is at its highest around events such as the Brexit, the Eurozone crisis, the US debt crisis and the US “fiscal cliff.”

To analyse Bitcoin returns and volatility, we collected daily data on US\$ prices for Bitcoin from investing (<https://www.investing.com>). Figure 2 shows the evolution of Bitcoin’s price, highlighting its high growth during 2017 and subsequent fall in 2018.

For gold, we collected daily data on US\$ prices from investing (<https://www.investing.com>). Figure 3 shows the evolution of the price of gold, highlighting how the highest gold prices occurred between 2011 and 2013, a period in which the effects of the global financial crisis were still being felt.

As a measure of the returns of Bitcoin and gold, we use the variation rate of the quoted prices on consecutive days, that is:

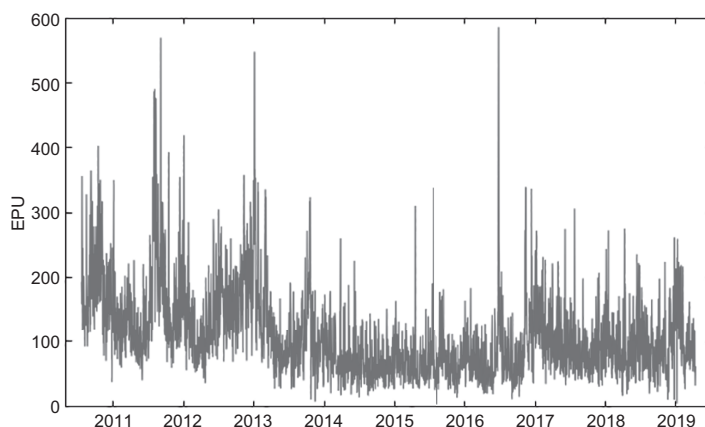


Figure 1.
Economic policy
uncertainty for the
period 19 July 2010–11
April 2019

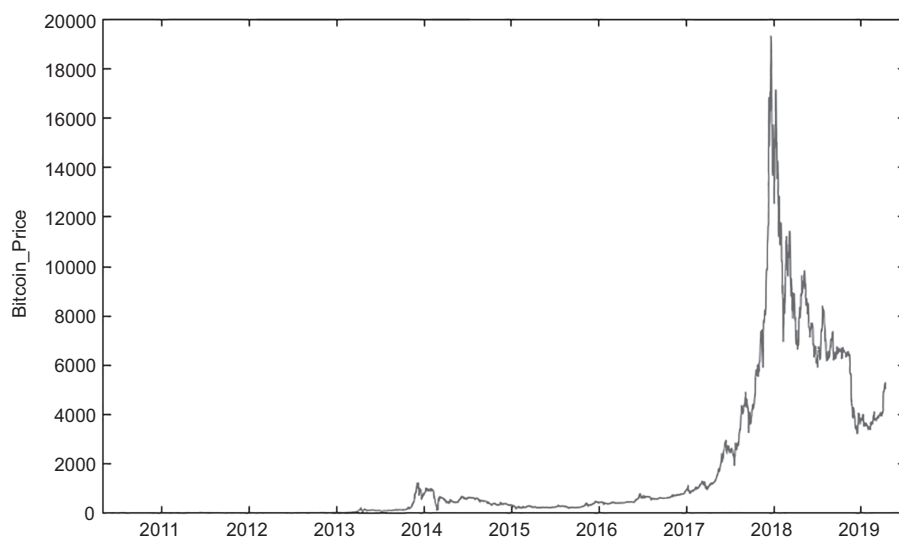


Figure 2.
Bitcoin price for the
period 19 July 2010–11
April 2019

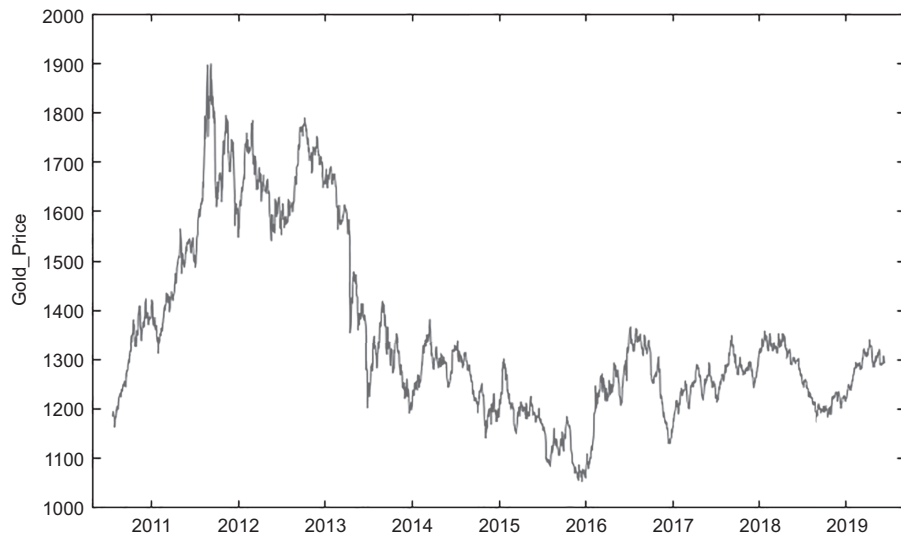
$$R_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} \quad (1)$$

where $R_{i,t}$ represents the return on asset i on day t and $P_{i,t}$ the closing price of asset i on day t .

To study volatility, we chose two proxy measures to account for the lack of consensus on the more appropriate volatility proxy as well as the possible sensitivity of the results to the choice of proxy.

Following the measure proposed by Chen and Zheng (2008), daily volatility is estimated as the difference between the highest quoted price reached minus the lowest quoted price obtained on the day, divided by the average of both, that is:

Figure 3.
Gold price for the
period 19 July 2010–11
April 2019



$$V_{1,i,t} = \frac{P_{i,t}^H - P_{i,t}^L}{(P_{i,t}^H + P_{i,t}^L) / 2} \quad (2)$$

where $V_{1,i,t}$ represents the volatility of the asset i on day t with this estimator, $P_{i,t}^H$ the maximum price of the asset i on day t and $P_{i,t}^L$ the minimum price of the asset i on day t .

The other measure we used to estimate daily volatility is Parkinson's volatility (1980), which is the most frequent range-based volatility estimator (Molnár, 2012). This estimator, based on the differences between high and low prices, is considered much less noisy than squared yields (Huisman *et al.*, 2012), that is:

$$V_{2,i,t} = \sqrt{365} \sqrt{\frac{\ln(P_{i,t}^H / P_{i,t}^L)^2}{4 \ln(2)}} \quad (3)$$

where $V_{2,i,t}$ represents the volatility of the asset i on day t with this estimator.

Table I shows the descriptive statistics of the EPU levels, the returns and volatility of Bitcoin and the returns and volatility of the gold. It highlights how gold returns show the highest dispersion (measured by its coefficient of variation (CV)), followed by Bitcoin's returns, reaching maximum daily returns of 5.29 per cent and 336.75 per cent, respectively. As for asymmetry and kurtosis, their coefficients reveal that all the analysed variables are biased and have a leptokurtic distribution, especially marked in the Bitcoin returns. These findings clearly show that the distributions of these variables are not normal, so they provide a good motivation to apply a quantile-based approach to adapt to extreme values.

4. Methodology

We used simple linear regression with ordinary least squares to study the influence of EPU on the conditional expectation of the returns and volatility of Bitcoin and gold and quantile

regression to study the influence of EPU on the extreme quantiles of the return and volatility of Bitcoin and gold.

Our descriptive analysis shows that the variables under the study are not normal, with long tails to the right and high kurtosis. This suggests the appropriateness of applying a quantile-based approach. At the same time, since the goal of this study is to analyse whether Bitcoin behaves as a speculative asset or as a safe haven – as gold is often considered – it is interesting to evaluate the impact of EPU on the returns and volatility of Bitcoin and gold in the most extreme quantiles. Based on the definition of EPU, a more significant impact of EPU could be expected on the returns and volatility of Bitcoin and gold in its higher values when the feeling of investor insecurity is stronger. In addition, an advantage of quantile regression with respect to simple linear regression with ordinary least squares is that quantile regression estimates are more robust with regard to extreme values in response measurements (Koenker, 2005).

Thus, the models of simple linear regression with ordinary least squares used to analyse the influence of EPU on the returns and volatility of Bitcoin and gold can be defined as:

$$R_{i,t} = \alpha + \beta \text{EPU}_t + \varepsilon_t \quad (4)$$

$$V_{i,t} = \alpha + \beta \text{EPU}_t + \varepsilon_t \quad (5)$$

where $R_{i,t}$ and $V_{i,t}$ represent the returns and volatility of the asset i , respectively, on day t , α the constant of the model, EPU_t the EPU level on day t , β the intensity of the influence of the fluctuations of EPU_t on $R_{i,t}$ and $V_{i,t}$, respectively, and ε_t the error term.

To model the influence of EPU on the most extreme quantiles of the returns and volatility of Bitcoin and gold, the quantile regression models proposed can be defined as:

$$R_{i,t} = \alpha_\tau + \beta_\tau \text{EPU}_t + \varepsilon_{t,\tau} \quad (6)$$

$$V_{i,t} = \alpha_\tau + \beta_\tau \text{EPU}_t + \varepsilon_{t,\tau} \quad (7)$$

being τ the quantile with a value between 0 and 1. In the study, we focus on the most extreme quantiles, so τ will take the values of 0.01, 0.05, 0.1, 0.25, 0.75, 0.9, 0.95 and 0.99.

5. Results

We studied the influence of EPU on the returns and volatility of Bitcoin and gold with linear regression with ordinary least squares and quantile regression.

	EPU	R_{Bit}	$V_{1,\text{Bit}}$	$V_{2,\text{Bit}}$	R_{Gold}	$V_{1,\text{Gold}}$	$V_{2,\text{Gold}}$
Mean	108.530	0.0063	0.0714	0.8101	0.0001	0.0137	0.1572
Median	92.1700	0.0000	0.0426	0.4883	0.0007	0.0118	0.1350
Minimum	3.3200	-0.5721	0.0000	0.0000	-0.0954	0.0000	0.0000
Maximum	586.5500	3.3675	2.0000	12.625	0.0529	0.1127	1.2949
Standard deviation	65.0810	0.0919	0.1041	1.0917	0.0092	0.0084	0.0959
CV	0.5997	14.7010	1.4591	1.3477	116.94	0.6103	0.6104
Asymmetry	1.7127	16.9470	6.8572	4.4549	-0.7605	2.8623	2.8652
Kurtosis excess	4.9469	579.6600	88.0270	29.173	9.8983	17.386	17.427

Table I.
Descriptive statistics of
the variables from the
period 19 July 2010 – 11
April 2019

The simple linear regression model was used to analyse the influence of EPU on Bitcoin returns. (Table II) shows a positive but not significant β coefficient. However, there is a positive and significant influence of EPU on gold returns. These results suggest that the uncertainty generated by governments and central banks has no explanatory power over Bitcoin returns. Based on this result, it could not be said that Bitcoin acts as a safe haven or hedge for the uncertainty surrounding the economic system. In turn, several studies have shown that EPU has a negative and significant impact on stock returns (Dzielinski, 2012; Antonakakis *et al.*, 2013; Adjei and Adjei, 2017, amongst others). Consequently, the results do not support the assertion that Bitcoin plays the role of a simple speculative asset.

When studying the influence of EPU on Bitcoin and gold volatility using the volatility measure proposed by Chen and Zheng (2008) with simple linear regression (Table III), there is a positive and significant relationship between EPU and Bitcoin volatility, as well as between EPU and gold volatility with a significance level lower than 0.0001.

Using Parkinson's (1980) volatility measure (Table IV), we observe that the relationship found with the measure of volatility of Chen and Zheng (2008) between EPU and Bitcoin and gold volatility is maintained with a significance level lower than 0.001. Based on these results, it could be asserted that Bitcoin can take the role of a safe haven during times of uncertainty, as well as the role of a speculative asset, since investor insecurity – as described by EPU – has a positive impact on the movement of Bitcoin prices, behaviour that matches that of gold. With this result, following Fang *et al.* (2019), it could be said that Bitcoin behaves like a hedge or safe haven. Based on Eom *et al.* (2019), Bitcoin could also be considered as a speculative asset since it shows the typical characteristics of these assets: dependence on investor sentiment and high volatility.

However, since we are modelling the influence of a sentiment, as that generated by EPU on investors, it seems wise to take a closer look at the influence of EPU on the returns and volatility of Bitcoin and gold at its extreme levels (measured by its quantiles 0.01, 0.05, 0.1, 0.25, 0.75, 0.9, 0.95 and 0.9). We do this by applying quantile regression.

Table V shows how the influence of EPU on Bitcoin and gold returns differs at lower and higher quantiles. At lower quantiles, it is found that EPU has a negative impact on Bitcoin returns, except at the 0.25 quantile, this impact being significant only at the 0.01 quantile. Regarding gold, it is found that EPU has a negative impact on gold returns at the 0.05 and 0.01 quantiles, but these impacts are not significant. However, at higher quantiles, the influence of EPU on Bitcoin returns turns out to be positive and significant in the 0.99 and 0.9 quantiles. Similarly, it is observed how EPU has a positive impact on gold returns in the quantiles 0.75, 0.9, 0.95 and 0.99, this impact being significant in the 0.75, 0.9 and 0.95 quantiles. The positive influence of EPU on Bitcoin returns found is in line with studies such as those by Bouri *et al.* (2017a), Selmi *et al.* (2018) and Demir *et al.* (2018). The fact that at the highest investor uncertainty levels (as expressed by EPU values) Bitcoin returns increase, conveys characteristics of a hedge or safe haven. Just like gold, Bitcoin shows an increase in its returns during more uncertain times, when a conventional speculative asset, such as stocks, would see its returns reduced.

Table II.
Estimates of the influence of EPU on Bitcoin and gold returns with the simple linear regression Model for the period 19 July 2010–11 April 2019

Coefficients	Estimate	R_{Bit}			R_{Gold}			
		Standard error	t value	Pr ($> t $)	Estimate	Standard error	t value	Pr ($> t $)
(Intercept)	0.00411	0.00317	1.2970	0.1946	-0.00091	0.00037	-2.458	0.0140**
EPU	0.00002	0.00002	0.7901	0.4295	0.00001	0.00001	3.111	0.0019***

Note(s): ***, ** and * indicate the significance at 1%, 5% and 10% levels, respectively

Coefficients	$V_{1, \text{Bit}}$			$V_{1, \text{Gold}}$				
	Estimate	Standard error	t value	Pr ($> t $)	Estimate	Standard error	t value	Pr ($> t $)
(Intercept)	0.05851	0.00358	16.360	<0.0001***	0.01209	0.00034	35.980	<0.0001***
EPU	0.00012	0.00003	4.194	<0.0001***	0.00002	0.00001	5.555	<0.0001***

Note(s): ***, ** and * indicates the significance at 1%, 5% and 10% levels, respectively

Table III.
Estimates of the influence of EPU on Bitcoin and gold volatility (Eqn 2) with the simple linear regression model for the period 19 July 2010–11 April 2019

Table IV.
Estimates of the influence of EPU on Bitcoin and gold volatility (Eqn 3) with the simple linear regression model for the period 19 July 2010–11 April 2019

Coefficients	$V_{2, \text{Bit}}$			$V_{2, \text{Gold}}$				
	Estimate	Standard error	t value	Pr ($> t $)	Estimate	Standard error	t value	Pr ($> t $)
(Intercept)	0.69990	0.03753	18.65	<0.0001***	0.13876	0.00386	35.98	<0.0001***
EPU	0.00102	0.00030	3.422	0.0006***	0.00018	3.17e-5	5.556	<0.0001***

Note(s): ***, ** and * indicates the significance at 1%, 5% and 10% levels, respectively

τ	Coefficient	R_{Bit}				R_{Gold}			
		Value	Standard error	t value	Pr ($> t $)	Value	Standard error	t value	Pr ($> t $)
0.01	(Intercept)	-0.12650	0.02591	-4.8812	<0.0001***	-0.02115	0.00374	-5.64767	<0.0001***
	EPU	-0.00062	0.00030	-2.0334	0.0421**	-0.00004	0.00004	-1.13347	0.25713
0.05	(Intercept)	-0.06680	0.00740	-9.0332	<0.0001***	-0.01246	0.00133	-9.34508	<0.0001***
	EPU	-0.00007	0.00008	-0.8762	0.3810	-0.00002	0.00001	-1.63203	0.10281
0.1	(Intercept)	-0.03993	0.00425	-9.4027	<0.0001***	-0.00918	0.00085	-10.82975	<0.0001***
	EPU	-0.00003	0.00004	-0.6677	0.5044	0.00000	0.00001	-0.44671	0.65513
0.25	(Intercept)	-0.01428	0.00145	-9.8780	<0.0001***	-0.00428	0.00046	-9.30504	<0.0001***
	EPU	0.00003	0.00001	3.1226	0.0018***	0.00000	0.00000	1.00389	0.31554
0.75	(Intercept)	0.02098	0.00179	11.7249	<0.0001***	0.00285	0.00034	8.29044	<0.0001***
	EPU	-0.00002	0.00001	-1.3070	0.1913	0.00002	0.00000	4.82690	<0.0001***
0.9	(Intercept)	0.04457	0.00406	10.9693	<0.0001***	0.00748	0.00092	8.12939	<0.0001***
	EPU	0.00008	0.00004	1.7781	0.0755*	0.00002	0.00001	2.38219	0.01729**
0.95	(Intercept)	0.07818	0.01184	6.6030	<0.0001***	0.01014	0.00084	12.05444	<0.0001***
	EPU	0.00012	0.00011	1.1215	0.2622	0.00003	0.00001	2.68226	0.00736***
0.99	(Intercept)	0.08579	0.03738	2.2949	0.0218**	0.01773	0.00357	4.96655	<0.0001***
	EPU	0.00168	0.00058	2.8882	0.0039***	0.00006	0.00004	1.43692	0.15088

Note(s): ***, ** and * indicate the significance at 1%, 5% and 10% levels, respectively

Table V.
Estimates of the
Influence of EPU on
Bitcoin and gold
returns with the
quantile regression
model for the period 19
July 2010–11
April 2019

When analysing the influence of EPU on the volatility of Bitcoin in its extreme quantiles, taking the measure proposed by Chen and Zheng (2008) as a volatility estimator (Table VI), we can see how at lower quantiles (except 0.01), the influence of EPU on Bitcoin volatility is negative and significant. In contrast, EPU has a positive impact on gold volatility at lower quantiles (except 0.01), however, in no case is such impact significant. Focussing on higher quantiles, it is found that EPU is positively related to Bitcoin and gold volatility levels, being significant in the 0.75, 0.9 and 0.95 quantiles.

Taking Parkinson's volatility (1980) as a volatility estimator (Table VII), we observe that the influence of EPU on Bitcoin volatility is negative and significant in the lower quantiles, but positive and significant in the higher quantiles (except in the quantile 0.99 which is not significant). Similarly, using this volatility estimator, the influence of EPU on gold volatility is negative and significant in the lowest quantiles (except at the 0.25 quantile), but positive and significant at the highest quantiles.

These results show that the greater the uncertainty generated by governments and central banks regarding the economic policies they will carry out, the greater information asymmetry is (Akerlof, 1970) and, therefore, the greater the asymmetry in investors' individual expectations are. This result is in line with the findings of Eom *et al.* (2019) and Fang *et al.* (2019) and supports the literature that suggests that Bitcoin is not a simple means of exchange and store of value, but an investment asset, just like gold.

The findings regarding the influence of EPU on the volatility of Bitcoin allow us to affirm that Bitcoin is not only a means of exchange but that it also shows characteristics of an investment asset that reacts significantly to the uncertainty related to the economic system, just like gold. Regarding its consideration as a safe haven or a simple speculative value, the positive influence that EPU has on Bitcoin returns at higher quantiles, coincident with the behaviour of gold returns, allows us to defend that Bitcoin acts as a safe haven during more uncertain times.

6. Conclusions

The rapid growth of Bitcoin, its great capacity to recover during periods of turbulence and its high volatility, amongst other characteristics, has motivated a growing interest in the literature to understand the economic and financial determinants that could influence the price of Bitcoin. In this line, a debate has been generated regarding the role played by this cryptocurrency, is it a simple means of exchange and store of value, a speculative asset or a safe haven?

In this study, we aim to respond this question by studying the influence of EPU on Bitcoin returns and volatility. Our main assumption is that when investors feel insecure because of uncertainty regarding the fiscal, regulatory and monetary policies that may be implemented; hedges or safe havens should increase their returns and volatility, while the typical speculative assets should increase their volatility and reduce their returns. In order to obtain more robust results, we take gold as a reference safe haven and compare the behaviour of Bitcoin and gold against EPU.

The EPU measure of Baker *et al.* (2016) was used to analyse the influence of EPU on the returns and volatility of Bitcoin and gold for the period from 19 July 2010 to 11 April 2019. To thoroughly analyse this influence, two different methodologies were used: simple linear regression with ordinary least squares and quantile regression.

The results obtained when studying the influence of EPU on Bitcoin and gold returns by using simple linear regression with ordinary least squares have shown that EPU positively influences Bitcoin and gold returns for the whole sample. However, only the influence on gold returns is statistically significant. Analysing the influence of EPU on Bitcoin and gold volatility with two measures of volatility, shows that EPU positively and significantly

τ	Coefficient	$V_{1, \text{Bit}}$			$V_{1, \text{Gold}}$				
		Value	Standard error	t value	Pr ($> t $)	Value	Standard error	t value	Pr ($> t $)
0.01	(Intercept)	2.24e-12	0.00117	1.92e-9	1.000	0.00209	0.00061	3.42449	0.00063***
	EPU	0.00000	9.21e-6	-2.19e-9	1.000	-0.00001	0.00000	-1.28578	0.19865
0.05	(Intercept)	0.01500	0.00085	17.6430	<0.0001***	0.00568	0.00035	16.40935	<0.0001***
	EPU	-0.00009	0.00001	-16.1776	<0.0001***	0.00000	0.00000	-1.08193	0.27940
0.1	(Intercept)	0.01889	0.00069	27.3523	<0.0001***	0.00670	0.00022	29.99340	<0.0001***
	EPU	-0.00008	0.00001	-13.1024	<0.0001***	0.00000	0.00000	-0.89404	0.37139
0.25	(Intercept)	0.02509	0.00093	26.9404	<0.0001***	0.00853	0.00028	30.25833	<0.0001***
	EPU	-0.00002	0.00001	-2.9173	0.0036***	0.00000	0.00000	0.29503	0.76800
0.75	(Intercept)	0.07021	0.00420	16.7169	<0.0001***	0.01484	0.00068	21.86400	<0.0001***
	EPU	0.00012	0.00004	3.1697	0.0015***	0.00002	0.00001	2.45110	0.01432**
0.9	(Intercept)	0.11843	0.01412	8.3863	<0.0001***	0.01923	0.00088	21.76846	<0.0001***
	EPU	0.00027	0.00015	1.7677	0.0772*	0.00004	0.00001	4.36335	<0.0001***
0.95	(Intercept)	0.14169	0.02310	6.1349	<0.0001***	0.02313	0.00107	21.64825	<0.0001***
	EPU	0.00097	0.00027	3.6582	0.0003***	0.00005	0.00001	4.09126	<0.0001***
0.99	(Intercept)	0.30609	0.07566	4.0456	<0.0001***	0.03779	0.00629	6.00428	<0.0001***
	EPU	0.00136	0.00086	1.5894	0.1121	0.00006	0.00005	1.20897	0.22680

Note(s): ***, ** and * indicates the significance at 1%, 5% and 10% levels, respectively

Table VI.
Estimates of the
Influence of EPU on
Bitcoin and gold
volatility (Eqn 2) with
the quantile regression
model for the period 19
July 2010–11
April 2019

Table VII.
Estimates of the
Influence of EPU on
Bitcoin and gold
volatility (Eqn 3) with
the quantile regression
model for the period 19
July 2010–11
April 2019

τ	Coefficient	$V_{z, \text{Bit}}$			$V_{z, \text{Gold}}$				
		Value	Standard error	t value	Pr ($> t $)	Value	Standard error	t value	Pr ($> t $)
0.01	(Intercept)	1.57e-10	6.46e-11	2.428	0.0153**	0.02394	0.00279	8.568	<0.0001***
	EPU	-1.42e-12	5.11e-13	-2.778	0.0055***	-6.37e-5	2.29e-5	-2.772	0.0056***
0.05	(Intercept)	0.17211	0.01068	16.11	<0.0001***	0.06521	0.00384	16.98	<0.0001***
	EPU	-0.00101	8.44e-5	-11.91	<0.0001***	-5.53e-5	3.16e-5	-1.752	0.0798*
0.1	(Intercept)	0.21691	0.00894	24.28	<0.0001***	0.07684	0.00265	29.04	<0.0001***
	EPU	-0.00092	7.06e-5	-13.03	<0.0001***	-2.12e-5	2.17e-5	-0.9735	0.3304
0.25	(Intercept)	0.28930	0.01266	22.85	<0.0001***	0.09792	0.00277	35.33	<0.0001***
	EPU	-0.00032	0.00010	-3.156	0.0016***	9.60e-6	2.28e-5	0.4213	0.6736
0.75	(Intercept)	0.80611	0.05008	16.10	<0.0001***	0.17028	0.00535	31.85	<0.0001***
	EPU	0.00140	0.00040	3.527	0.0004***	0.00019	4.39e-5	4.402	<0.0001***
0.9	(Intercept)	1.40261	0.09933	14.12	<0.0001***	0.22064	0.01115	19.79	<0.0001***
	EPU	0.00252	0.00079	3.205	0.0014***	0.00044	9.17e-5	4.807	<0.0001***
0.95	(Intercept)	1.65342	0.25442	6.499	<0.0001***	0.26542	0.01319	20.12	<0.0001***
	EPU	0.01078	0.00201	5.362	<0.0001***	0.00052	0.00011	4.824	<0.0001***
0.99	(Intercept)	5.10445	1.74611	2.923	0.0035***	0.43367	0.04388	9.883	<0.0001***
	EPU	0.01770	0.01380	1.283	0.1998	0.00074	0.00036	2.043	0.0412**

Note(s): ***, ** and * indicates the significance at 1%, 5% and 10% levels, respectively

influences the volatility of both Bitcoin and gold for the whole sample. Nevertheless, when analysing the influence of this uncertainty on extreme quantiles with quantile regression, it was found that EPU has a negative impact on Bitcoin returns in the lowest quantiles and a positive impact on these returns in the highest quantiles. The effect found of EPU on volatility shows that EPU increases Bitcoin and gold volatility at the highest quantiles, with no coincidence for the lowest quantiles.

These results suggest that Bitcoin does not only act as a means of exchange or store of value but it also has characteristics of investment assets, such as its dependence on investor sentiment and high volatility. In turn, the fact that Bitcoin returns increase in the highest quantiles, as gold does, supports the role of Bitcoin as a safe haven during more uncertain times and discards its role as a simple speculative asset, such as shares. Also, knowing that Bitcoin acts as a safe haven not only allows it to be considered as a tool to protect savings in times of economic uncertainty but also qualifies it as a relevant asset for constructing diversified portfolios.

These findings provide useful information to investors, both individuals and professionals, by demonstrating Bitcoin's behaviour in situations of uncertainty regarding economic policies. The fact that Bitcoin's returns and volatility are affected by EPU suggests that investors can use information on EPU to make better investment decisions about Bitcoin, allowing them to consider this cryptocurrency as another investment instrument, and not as a means of exchange, which was the main purpose for which it was created. Based on this, investors can benefit from this information in three ways. First, by demonstrating the influence of EPU on Bitcoin's returns and volatility, investors can use information on EPU to make better investment decisions about Bitcoin. Second, the finding that Bitcoin can be a safe haven, like gold, allows investors to consider this cryptocurrency as a tool to protect their savings in times of economic uncertainty. Finally, the role played by Bitcoin found, in turn, may be relevant in the formation of investment portfolios, because this cryptocurrency can contribute to the construction of better diversified portfolios. Our findings are also relevant for economic policy makers, demonstrating how the uncertainty surrounding their policy development and implementation has a manifest impact on investment assets.

Although the results obtained in this study are relevant for the literature on the role played by Bitcoin in the face of uncertainty, this study is not without limitations. In this study, we take as a measure of economic policy uncertainty the daily US EPU index, as well as the prices of Bitcoin in US\$. Future research could analyse whether our results are sensitive to the use of other uncertainty measures and other Bitcoin data denominated in a currency other than US\$. Likewise, in this work the effect of EPU on other cryptocurrencies has not been considered. The study of more cryptocurrencies could help understand the potential determinants of the behaviour of these cryptocurrencies in the face of EPU. Finally, this work has not been raised to obtain efficient portfolios including Bitcoin, being interesting to advance in the study of the construction of efficient portfolios incorporating these cryptocurrencies. Despite the fact that there are already incipient studies in this line, there is still much to be done.

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Gamification in sport apps: the determinants of users' motivation

Gamification in
sport apps

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Abstract

Purpose – Gamification is a tool with great potential to motivate individuals to increase their physical activity. That is why sport apps for mobile devices, such as Nike+ or Strava, have integrated game elements. There is, however, little evidence of gamification's effectiveness in this field. Therefore, the aim of the present study is to analyze the impact of game elements included in gamified sports' apps on the satisfaction of basic psychological needs (i.e. competence, autonomy and relatedness). Similarly, the research analyzes the impact of these needs on autonomous motivation.

Design/methodology/approach – To achieve these goals, data were collected from users of gamified sport apps, using an online questionnaire. The data were analyzed using partial least squares structural equation modeling.

Findings – The results showed that interaction in the app with achievement-related game elements satisfied the needs for competence, autonomy and relatedness; social-related elements satisfied the need for relatedness; and immersion-related elements satisfied the needs for competence and autonomy. Similarly, satisfaction of the needs for autonomy and relatedness while using the app is crucial to experience autonomous motivation.

Practical implications – The findings of this study provide guidelines for practitioners and app developers.

Originality/value – Based on self-determination theory, the paper provides new insights into the relationship between game elements included in sport apps and individuals' basic psychological needs and motivation.

Keywords Gamification, Sport apps, Game elements, Self-determination theory, Motivation

Paper type Research paper

Received 20 September 2019
 Revised 29 January 2020
 Accepted 29 March 2020

1. Introduction

Over the last few years, many organizations have shown increased interest in using game elements to motivate people to behave in certain ways (Koivisto and Hamari, 2019a). The success of this practice, known as “gamification,” has received great attention from both academics and professionals (Hamari and Parvinen, 2018).

The underlying concept of gamification is the application of game design elements (e.g. points, rules, challenges, rewards, competition) in non-game contexts (Deterding *et al.*, 2011; Seaborn and Fels, 2015) to harness the motivational and attractive power of games to allow people to achieve higher levels of motivation. This trend has been observed in a variety of fields, such as tourism (Sigala, 2015), education (Connolly *et al.*, 2012), marketing (Lucassen and Jansen, 2014) and finance (Baptista and Oliveira, 2017). Koivisto and Hamari (2019a) also pointed out that gamification is particularly beneficial in contexts where individuals need to display long-term commitment and persistence in behaviors, and in contexts generally associated with procrastination. Hence, an area which has received special attention from

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This study was supported by the Government of Spain and the European Regional Development Fund (project ECO2017-82103-P) and by the Government of Aragon (pre-doctoral grant BOA 15/11/2019 and GENERES Group S-54_17R) co-financed by FEDER 2014-2020 'Building Europe from Aragon'.



European Journal of Management
and Business Economics
Vol. 29 No. 3, 2020
pp. 365-381
Emerald Publishing Limited
e-ISSN: 2444-8494
p-ISSN: 2444-8451
DOI 10.1108/EJMBE-09-2019-0163

both academics (Matallaoui *et al.*, 2017) and professionals (Koivisto and Hamari, 2019b) is health and sports.

Gamification has been postulated as an effective tool for motivating people to increase their physical activity (Chen and Pu, 2014) and improve their mood (Huang *et al.*, 2017). In this sense, there has been a remarkable increase in gamified sport apps, such as Nike+, Strava, Fitbit and Endomondo (Edwards *et al.*, 2016), in parallel with the growth of gaming apps in mobile devices. Applying the principles of gamification, these apps include various game elements (e.g. challenges, medals, rankings, competitions, avatars) to encourage and maintain behavioral habits associated with physical exercise. In this way, they influence people to perceive exercise as an interesting, enjoyable and fun activity, and thereby increase their motivation.

Although there is a growing literature on gamification, there are important shortcomings of previous research with regard to theoretical, empirical and methodological issues. First, despite the suitability of motivational frameworks, such as self-determination theory (Ryan and Deci, 2000), to understand gamification effects, previous studies have noticed that there is a lack of theoretical foundation to explain the motivational effects of gamification and that few studies are based on theoretical frameworks (Hamari *et al.*, 2014; Seaborn and Fels, 2015; Johnson *et al.*, 2016; Matallaoui *et al.*, 2017; Sailer *et al.*, 2017). Second, evidence about the effectiveness of gamification in the context of health and well-being is also scarce (Edwards *et al.*, 2016; Johnson *et al.*, 2016; Sardi *et al.*, 2017; Koivisto and Hamari, 2019b). Third, recent literature reviews have revealed a lack of knowledge about the effects of the different game elements, as most studies have focused on analyzing gamification as a uniform concept (Johnson *et al.*, 2016; Sailer *et al.*, 2017). Another problem in previous studies is that many of them have focused on analyzing users' behaviors (Johnson *et al.*, 2016; Hamari, 2017) and have not considered psychological variables (Seaborn and Fels, 2015), such as motivation. Finally, many of the studies on gamification have been criticized for their lack of validated instruments (Matallaoui *et al.*, 2017).

To address these gaps, this research seeks to better understand how gamification increases individuals' motivation. Specifically, based on self-determination theory, this study empirically analyzes the impact of various game elements included in sport apps on the satisfaction of the three basic psychological needs of competence, autonomy and relatedness, and their influence on autonomous motivation.

This study contributes to the literature in various ways. First of all, it fills an existing gap in the current academic literature on gamification. Drawing on self-determination theory, one of the most influential theories of human motivation, it responds to calls for more research examining gamification effects on users' motivation in the specific context of gamified sport apps. In addition, it extends previous gamification research by empirically analyzing how different game elements influence individuals' basic psychological needs and motivation. Finally, the study has practical implications for gamified apps designers as it offers useful advice on how to design gamified applications.

2. Self-determination theory

At the core of gamification is the use of the motivational power of games to promote and drive certain individual behaviors (Robson *et al.*, 2015). Taking this into account, to create effective gamified experiences, it is very important to understand individuals' motivational processes.

One of the most commonly used theories to analyze human motivation is self-determination theory (Deci, 1975), which initially distinguished two types of motivation: intrinsic and extrinsic. People who display intrinsically motivated behaviors are actively engaged with their tasks, find them interesting and do not seek other results beyond fun (Ryan and Deci, 2000). However, many activities are not perceived as interesting by humans,

and, therefore, their motivation has to be acquired extrinsically, through a kind of external regulation (Deci and Ryan, 2015). Self-determination proposes that extrinsically motivated behaviors can vary in the degree to which they are controlled as opposed to autonomous (Deci *et al.*, 1996), resulting in four sub-categories of extrinsic motivation: external regulation, introjected regulation, identified regulation and integrated regulation. First, external regulation is presented as the least autonomous (i.e. most controlled) form of extrinsic motivation, since individuals' behavior is externally controlled by others; that is, they act to achieve tangible rewards or avoid punishments determined by others (Deci and Ryan, 2000). The next level is introjected regulation, which refers to behaviors motivated by internal pressures (Deci and Ryan, 2000). This type of motivation is related to the ego, as people act to demonstrate their ability or to avoid guilt and shame (Ryan and Deci, 2000). The following level of extrinsic motivation is identified regulation, which corresponds to behaviors that occur when individuals identify themselves with the value of their behaviors and do not act only because they think they are supposed so to do (Deci and Ryan, 2000). Finally, integrated regulation is the most autonomous (or self-determined) form of extrinsic motivation, as the individual assimilates external regulations and acts with total willingness (Deci *et al.*, 1996).

With this subdivision of extrinsic motivation, the initial differentiation within self-determination theory (i.e. intrinsic vs extrinsic motivation) shifted to a focus on autonomous versus controlled motivation. Autonomous motivation "involves behaving with a full sense of volition and choice" (Deci and Ryan, 2008, p. 14) and is comprised of identified and integrated forms of extrinsic motivation and intrinsic motivation. On the other hand, controlled motivation "involves behaving with the experience of pressure and demand toward specific outcomes that comes from forces perceived to be external to the self" (Deci and Ryan, 2008, p. 14). External and introjected forms of extrinsic motivation are considered forms of controlled motivation. Finally, self-determination theory also posits amotivation as the lack of motivation to carry out target behavior (Deci and Ryan, 2000).

Depending on the type of motivation that individuals possess, they tend to behave in different ways. Specifically, people who are motivated autonomously behave voluntarily because they consider their tasks as interesting and enjoy them. On the other hand, people with controlled motivation behave through obligation, which leads them to experience pressure (Deci and Ryan, 2015). Therefore, to achieve the best outcomes from any form of activity, it is preferable that individuals are autonomously motivated.

Taking the importance of autonomous motivation into account, self-determination theory has analyzed the factors that facilitate it. Specifically, cognitive evaluation theory (Ryan and Deci, 2000), a sub-theory of self-determination theory, proposes that satisfaction of individuals' basic psychological needs fosters greater autonomous motivation. According to this theory, in addition to basic physiological needs, such as eating, drinking and sleeping, humans have three basic psychological needs that they wish to meet: competence, autonomy and relatedness (Deci and Ryan, 2000). Competence is the individual's sense of ability to understand and develop an activity satisfactorily (White, 1959); autonomy is related to the capacity of choice (de Charms, 1968); relatedness is the feeling of belonging and connection with others (Baumeister and Leary, 1995).

Self-determination theory has been used to explain the motivation of individuals in a variety of contexts, such as education (van Roy and Zaman, 2019), work (de Cooman *et al.*, 2013) and health (Ng *et al.*, 2012). In addition, it has been applied in the context of games to investigate players' motivation and the factors that influence it (Ryan *et al.*, 2006). Specifically, it has been shown that games foster a sense of competition through challenges, feedback and rewards. In addition, they provide autonomy through strategic flexibility and the possibility of making choices about tasks and objectives. Finally, they support relatedness by allowing interactions between the players (Ryan *et al.*, 2006).

3. Research model and proposed hypotheses

According to Koivisto and Hamari (2019a), game elements can be classified into three groups: (1) achievement-related elements, (2) social-related elements and (3) player immersion-related elements.

The most often used game elements in gamification are achievement related. These include badges, points, leaderboards, virtual currencies, progress bars and different difficulty levels (Koivisto and Hamari, 2019a). Previous studies have analyzed the effects of these types of game elements on individuals. Ding *et al.* (2018) found that systems that contained badges, leaderboards and progress bars facilitated user engagement. Similarly, Hassan *et al.* (2019) found that leaderboards, medals and levels provide individuals with a feedback system on their performance, which leads to greater intention to continue using a specific gamified system. In addition, although some studies have considered achievement-related game elements as extrinsic motivational aspects that have no effect on basic psychological needs (Mekler *et al.*, 2017), most studies find that these gamification elements are positively associated with the satisfaction of the three basic psychological needs of competence, autonomy and relatedness (Xi and Hamari, 2019). For example, Peng *et al.* (2012; Sailer *et al.*, 2013, 2017; van Roy and Zaman, 2019) and leaderboards (Sailer *et al.*, 2013, 2017) provide positive feedback on individuals' performances by showing their achievements, which creates a feeling of competition. Similarly, van Roy and Zaman (2019) found that setting weekly challenges of gradually increasing difficulty in an educational environment provided a greater sense of competence, autonomy and relatedness. Sailer *et al.* (2017) showed that badges, leaderboards and graphics met the satisfaction of the need for autonomy by increasing the sense of task and creating meaning at game level. Finally, Sailer *et al.* (2013) established that leaderboards, which provide a team-level score, also facilitated team members' feelings of relatedness.

Social-related game elements include competition with others, teams, cooperation and social networking features (Koivisto and Hamari, 2019a). Previous studies have found a positive influence of teammates' relationships on their intention to do their best (Peng *et al.*, 2012), and competition with other teams has been found to facilitate a sense of belonging (van Roy and Zaman, 2019). These elements are also related to the satisfaction of the three basic psychological needs. For example, van Roy and Zaman (2019) confirmed that group competition had a positive impact on the promotion of the psychological needs of competence, autonomy and relatedness. On the other hand, Sailer *et al.* (2017) found that participants in a game involving teammates experienced higher levels of social relatedness. However, they did not prove this positive effect in the case of the need for autonomy. Finally, Xi and Hamari (2019) demonstrated that cooperation, competition and connection with social networking features facilitated the satisfaction of the needs for competence, autonomy and relatedness.

Finally, immersion-related elements mainly include avatars, narratives, stories and customization (Koivisto and Hamari, 2019a). Bormann and Greitemeyer (2015) found that narrative is positively associated with the satisfaction of the needs for competence, autonomy and relatedness. In the context of gamification in sport, Peng *et al.* (2012) showed that other immersion-related features, such as the possibility of customizing characters, positively influenced the satisfaction of the need for autonomy. Similarly, Kim *et al.* (2015) found that customization had a positive effect on autonomy. Sailer *et al.* (2013) also proposed that using stories and avatars facilitated a sense of autonomy. Finally, Sailer *et al.* (2017) confirmed there was a positive relationship between the use of avatars and stories and the satisfaction of the need for relatedness, whereas Xi and Hamari's (2019) study into online brand communities proved that avatars, narratives and customization had a positive influence on the satisfaction of the need for autonomy.

Taking these arguments into account, the following hypotheses are proposed:

- H1.* Achievement-related app elements facilitate the satisfaction of the needs for (a) Gamification in sport apps competence, (b) autonomy and (c) relatedness.
- H2.* Social-related app elements facilitate the satisfaction of the needs for (a) competence, (b) autonomy and (c) relatedness.
- H3.* Immersion-related app elements facilitate the satisfaction of the needs for (a) competence, (b) autonomy and (c) relatedness.

Self-determination theory posits that contexts that satisfy the basic psychological needs for competence, autonomy and relatedness facilitate autonomous motivation (Deci and Ryan, 2000), which, in turn, leads to more favorable psychological results and greater well-being (Ryan and Deci, 2000). This relationship has been proven in multiple contexts. In the specific area of games, Ryan *et al.* (2006) stated that games which allow players to feel competent, provide autonomy and facilitate relationships with other players promote greater intrinsic motivation. In the context of sports and health, Ng *et al.* (2012) also found a positive relationship between the satisfaction of psychological needs and autonomous motivation, which resulted in beneficial health outcomes. Similarly, Peng *et al.* (2012), in an analysis of exercise games, found that game characteristics which support competition and autonomy enhance players' enjoyment, their motivation to continue playing, and increase their intention to recommend the game. Finally, other authors, such as Edmunds *et al.* (2007), have found that satisfaction of the three basic psychological needs is associated with higher levels of exercise, motivation and well-being. Taking these arguments into account, we propose the following hypotheses:

- H4a.* The satisfaction of the need for competence has a positive impact on autonomous motivation.
- H4b.* The satisfaction of the need for autonomy has a positive impact on autonomous motivation.
- H4c.* The satisfaction of the need for relatedness has a positive impact on autonomous motivation.

Figure 1 shows the proposed model.

4. Methodology

4.1 Procedure

To test the hypotheses, a market study with users of gamified sport apps was conducted. Data collection took place between May and June 2019. Due to the difficulty to get access to

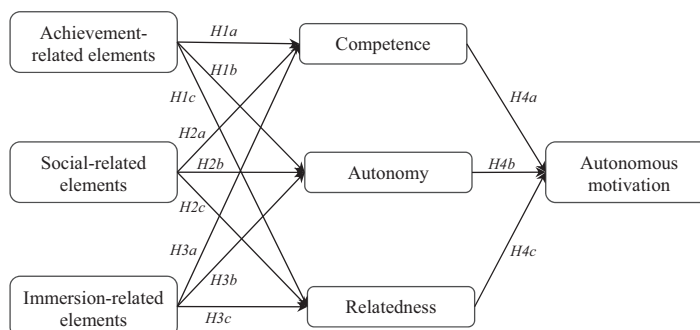


Figure 1.
Proposed model

users, a combination of convenience and snowball sampling was used. This sampling procedure has been used in previous studies in the context of gamification (e.g. Alahäivälä and Oinas-Kukkonen, 2016; Fitz-Walter *et al.*, 2017; Johnson *et al.*, 2017). An online questionnaire was sent to potential participants, including people practicing sports, sport clubs and personal trainers. The questionnaire was answered by a total of 321 individuals, of whom 156 (48.6%) were users of sport apps. Only users were selected for the study. Incomplete and non-valid questionnaires were discarded, obtaining a final sample of 153 valid questionnaires.

Early and late respondents were compared to assess the presence of non-response bias (Armstrong and Overton, 1977). A comparison of means on the scores of the included constructs was conducted. No significant differences were found between both groups. Therefore, non-response bias does not seem to be an issue of concern in this study.

Table 1 shows the profile of the final sample.

4.2 Measurement instrument

To measure the model's constructs, seven-point scales adapted from the previous literature were used. Individuals' perceptions of game elements related to achievement, social aspects

Category		Percentage (%)
Gender	Men	52.3
	Women	47.7
Age	<30 years old	39.2
	30–40 years old	19.6
	40–50 years old	29.4
	>50 years old	11.8
Weekly exercise	<1 h	1.96
	1–3 h	20.92
	3–6 h	42.48
	6–9 h	20.26
	9–12 h	10.46
	>12 h	3.92
The most-used apps	Garmin	20.9
	Strava	17.6
	Polar	12.4
	Runtastic	11.1
	Endomondo	9.2
	Nike+	4.6
	Fitbit	4.6
	Runkeeper	0.7
	Others	19.0
App experience	<3 months	5.9
	3–6 months	8.5
	6–12 months	9.2
	12–18 months	17.0
	18–24 months	14.4
Weekly use of the app	>24 months	45.1
	<30 min	23.5
	30–60 min	23.5
	1–3 h	23.5
	3–6 h	15.7
	6–9 h	8.5
	9–12 h	2.0
>12 h	3.3	

Table 1.
Sample characteristics

and immersion included in the apps were measured based on the scales proposed by Xi and Hamari (2019), which analyzed the frequency (1 = never, 7 = every time) and the importance (1 = not at all important, 7 = very important) of the players' interactions with each of the game elements. The satisfaction of the basic psychological needs for competence and relatedness was also measured by adapting items from Xi and Hamari (2019), and the need for autonomy was measured using items from Xi and Hamari (2019) and Standage *et al.* (2005). The items were scored on a seven-point Likert scale (1 = strongly disagree; 7 = strongly agree). Finally, autonomous motivation was conceptualized by joining intrinsic motivation and identified motivation, which were measured using scales proposed by Standage *et al.* (2005) on a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree). Table 2 shows the measurement scales used in this study.

4.3 Common method bias assessment

The present study relied on data from self-reported measures in a one-time survey. Therefore, both procedural and statistical methods were used to address common method bias (Podsakoff *et al.*, 2003). First, regarding the procedural methods, participation in the study was voluntary and the subjects were guaranteed anonymity and data confidentiality. According to Podsakoff *et al.* (2003), this reduces the possibility that participants will respond dishonestly or artificially. In addition, the dependent and independent variables were placed on different pages of the electronic survey, which prevented respondents from inferring cause-effect relationships among the constructs. Second, regarding the statistical procedures, a full collinearity test based on variance inflation factors (VIFs) was implemented. According to Kock (2015), this test specifies that a VIF value greater than 3.3 suggests the existence of common method bias. Our estimations showed that VIF values ranged from 1.115 to 2.577. Therefore, there is no evidence to suggest the presence of common method bias in this study.

5. Analyses and results

Partial least squares (PLS) structural equation modeling with SmartPLS 3.0 software was used to test the proposed model (Ringle *et al.*, 2015). PLS is more suitable than other methods, such as covariance-based structural equation modeling, when the conceptual model, as in our case, is complex and includes many indicators and latent variables, and constructs with formative indicators (Chin, 2010; Hair *et al.*, 2011). In addition, it is also more appropriate when the sample size is lower than 250 (Reinartz *et al.*, 2009).

5.1 Measurement model analyses

The proposed model includes both formative (interaction with achievement-related elements, interaction with social-related elements and interaction with immersion-related elements) and reflective constructs (satisfaction of the need for competence, satisfaction of the need for autonomy, satisfaction of the need for relatedness and autonomous motivation). Interaction with achievement-related game elements was conceptualized as a second-order formative construct composed of five first-order indicators: (1) badges/medals/trophies, (2) scores/points, (3) progress bars, (4) rankings/leaderboards and (5) increasingly difficult tasks. Similarly, interaction with social-related game elements was conceptualized as a second-order formative construct composed of (1) competition, (2) social networking features and (3) cooperation. Finally, interaction with immersion-related elements was conceptualized as a second-order formative construct composed of (1) profile/virtual identity/avatar and (2) personalization. Each of these first-order constructs was measured formatively by two

Constructs, items and sources

Achievement-related elements (adapted from Xi and Hamari, 2019)

A1	The frequency of interacting with badges/medals/trophies in the app
A2	The frequency of interacting with scores/points in the app
A3	The frequency of interacting with progress bars in the app
A4	The frequency of interacting with rankings/leaderboards in the app
A5	The frequency of interacting with increasingly difficult tasks in the app
A6	The importance of interacting with badges/medals/trophies in the app
A7	The importance of interacting with scores/points in the app
A8	The importance of interacting with progress bars in the app
A9	The importance of interacting with rankings/leaderboards in the app
A10	The importance of interacting with increasingly difficult tasks in the app

Social-related elements (adapted from Xi and Hamari, 2019)

S1	The frequency of interacting with competition in the app
S2	The frequency of interacting with social networking features in the app
S3	The frequency of interacting with cooperation in the app
S4	The importance of interacting with competition in the app
S5	The importance of interacting with social networking features in the app
S6	The importance of interacting with cooperation in the app

Immersion-related elements (adapted from Xi and Hamari, 2019)

I1	The frequency of interacting with profile/virtual identity/avatar in the app
I2	The frequency of interacting with personalization in the app
I3	The importance of interacting with profile/virtual identity/avatar in the app
I4	The importance of interacting with personalization in the app

Competence (adapted from Xi and Hamari, 2019)

C1	I think that I am pretty good when I use the app
C2	I am satisfied with my performance when I use the app
C3	I feel like an expert in the app
C4	I feel like a competent person when I use the app

Autonomy (adapted from Xi and Hamari, 2019; Standage et al., 2005)

A1	In this app I have different options
A2	I feel free to use this app
A3	I feel free to decide what activities to do in the app
A4	When I use the app, it is because I want to use it

Relatedness (adapted from Xi and Hamari, 2019)

R1	When I use the app, I feel like other people care what I do
R2	When I use the app, I feel supported by others
R3	When I use the app, I feel that I am a valuable person to others
R4	When I use the app, I feel that I am understood

Autonomous motivation

Intrinsic motivation (adapted from Standage et al., 2005)

IN1	I use the app because it is fun
IN2	I use the app because I like it
IN3	I use the app because it is interesting

Identified motivation (adapted from Standage et al., 2005)

ID1	I use the app because I want to do exercise
ID2	I use the app because it is important for me to do exercise
ID3	I use the app because I want to improve my physical condition

Table 2.
Measurement scales

indicators: frequency of interaction with the game element and the importance of the interaction with the game element.

First, the external validity of the formative measurement model was assessed by evaluating indicators' weights and loadings (see Table 3). The indicators of formative constructs should have statistically significant weights. However, according to Hair *et al.* (2017), indicators with non-significant weights but high loadings (i.e. above 0.50) have high absolute influence on the constructs, and should therefore be retained in the model. As can be seen in Table 3, while some indicators have low and non-significant weights, all have loadings above 0.50 and are significant, which indicates acceptable external validity (Hair *et al.*, 2017). In addition, collinearity was assessed based on the VIF values. According to Hair *et al.* (2011), a VIF value of 5 and higher indicates a potential collinearity problem. As can be seen in Table 3, the VIFs range from 1.107 to 3.539, all lower than 5, which suggests that multicollinearity is not a threat in this study.

Second, the reliability and validity of the reflective measurement model were assessed. The reliability was evaluated based on the criterion that factor loadings should be higher than 0.7 (Churchill, 1979). As Table 4 shows, all standardized factor loadings were above 0.7 and statistically significant at 0.01 (Carmines and Zeller, 1979), which indicates that individual item reliability was adequate. Moreover, all the constructs were internally consistent, as their composite reliabilities (CR) were greater than 0.7 (Nunnally and Bernstein, 1994). The constructs also met the convergent validity criteria, as the average variance extracted (AVE) values were above 0.5 (Fornell and Larcker, 1981). Finally, as Table 5 shows, discriminant validity was also demonstrated. In all cases, the square root of the AVE of any two constructs was greater than the inter-construct correlations (Fornell and Larcker, 1981).

5.2 Structural model analyses

The analysis of the proposed hypotheses was based on the examination of standardized paths, which were estimated using a bootstrapping procedure with 5,000 subsamples (Chin, 1998). The model accounted for 22.0% of the variation of the satisfaction of the need for competence, 20.8% of the variation of the satisfaction of the need for autonomy and 67.7% of variation of the satisfaction of the need for relatedness. Finally, it accounted for 20.8% of the variation in individuals' autonomous motivation. The predictive relevance of the model was assessed through the Stone–Geisser test. In particular, the results showed that the Q^2 values for the dependent variables were positive.

The results indicated that interaction with achievement-related game elements in the gamified app promoted the satisfaction of the needs for competence ($\beta = 0.307$; $t = 3.00$),

Variables	Items	Loading	<i>t</i> -value	Weight	<i>t</i> -value	VIF
Achievement-related elements	Badges/medals/trophies	0.870	19.25	0.350	2.77	2.146
	Scores/points	0.648	9.78	0.095	1.05	1.669
	Progress bars	0.578	7.31	0.129	1.14	1.707
	Rankings/leaderboards	0.940	25.50	0.592	4.18	2.313
Social-related elements	Increasingly difficult tasks	0.596	7.17	0.005	0.04	1.739
	Competition	0.833	13.43	0.468	4.14	1.634
	Social networking features	0.883	16.85	0.496	3.80	2.875
	Cooperation	0.886	21.95	0.914	1.58	3.559
Immersion-related elements	Profile/virtual identity/avatar	0.931	8.26	0.814	4.93	1.105
	Personalization	0.633	4.14	0.383	2.07	1.105

Table 3.
Formative measurement model results

autonomy ($\beta = 0.331; t = 3.26$) and relatedness ($\beta = 0.263; t = 3.23$), which support H1a, H1b and H1c, respectively. Similarly, interaction with social-related game elements was associated with the satisfaction of the need for relatedness ($\beta = 0.721; t = 6.50$), supporting H2c. However, we found no significant impact of social-related elements on the satisfaction of the needs for competence ($\beta = -0.141; t = 1.14$) and autonomy ($\beta = -0.140; t = 1.30$), thus rejecting H2a and H2b. Similarly, the results showed that interaction with immersion-related game elements favored the satisfaction of the needs for competence ($\beta = 0.344; t = 2.64$) and autonomy ($\beta = 0.314; t = 3.03$), which support H3a and H3b, respectively. However, contrary to the prediction, we found no significant impact of immersion-related game elements on the satisfaction of the need for relatedness ($\beta = -0.149; t = 1.53$), rejecting H3c.

The results also demonstrated that satisfaction of the needs for autonomy ($\beta = 0.377; t = 3.92$) and for relatedness ($\beta = 0.162; t = 1.77$) when using the gamified app was positively associated with individuals' autonomous motivation. Thus, H4b and H4c are accepted. On the contrary, satisfaction of the need for competence did not have a significant effect on autonomous motivation ($\beta = 0.002; t = 0.02$), which rejects H4a.

This study included as control variables weekly exercise, weekly use of the app and the length of time that users have been using the app (app experience). Furthermore, gender and

Variables	Items	Factor loading	CR	AVE	Q ²
Competence	C1	0.870	0.916	0.732	0.146
	C2	0.763			
	C3	0.897			
	C4	0.888			
Autonomy	A1	0.813	0.909	0.714	0.140
	A2	0.867			
	A3	0.896			
	A4	0.802			
Relatedness	R1	0.941	0.981	0.927	0.583
	R2	0.983			
	R3	0.975			
	R4	0.953			
Autonomous motivation	IN1	0.783	0.931	0.693	0.125
	IN2	0.883			
	IN3	0.877			
	ID1	0.825			
	ID2	0.854			
	ID3	0.767			

Table 4.
Reflective
measurement model
results

Note(s): CR: composite reliability; AVE: average variance extracted

	1	2	3	4	5	6	7
1. Achievement-related elements	N.A.						
2. Social-related elements	0.675	N.A.					
3. Immersion-related elements	0.538	0.696	N.A.				
4. Competence	0.397	0.306	0.411	0.856			
5. Autonomy	0.405	0.302	0.395	0.499	0.845		
6. Relatedness	0.670	0.796	0.495	0.341	0.268	0.963	
7. Autonomous motivation	0.371	0.317	0.364	0.194	0.372	0.222	0.833

Table 5.
Discriminant validity
analysis

Note(s): Diagonal values with the AVE square roots. Elements which are not in the diagonal are construct correlations. N.A.: not applied

age were considered. The results showed that individuals who have been users of the app for longer are less autonomously motivated than those who became users more recently.

Table 6 shows the summary of the results of the structural model.

6. Discussion

Due to its ability to motivate individuals, gamification has in recent years triggered great interest among academics and professionals from different sectors. One context where gamification has received special attention is in sport apps for mobile devices. Game elements (medals, rankings, progress bars, avatars, competition, etc.) are included in a variety of gamified sport apps to motivate individuals to perceive exercise as an interesting and fun activity.

Drawing on self-determination theory, this research proposes a model to understand how different categories of game elements in sport apps (achievement-oriented, social-oriented and immersion-oriented) facilitate the satisfaction of the basic psychological needs of individuals and their impact on autonomous motivation.

Specifically, based on the empirical results obtained, it can be concluded that interacting with achievement-related game elements (e.g. badges, results, progress bars, rankings and difficulty levels) while using gamified sport apps facilitates the satisfaction of the three psychological needs of competence, autonomy and relatedness. For instance, receiving medals/badges can create a feeling of competence, because these lead users to perceive they have the required skills to successfully achieve their goals. On the other hand, elements such as progress bars and difficulty levels can create a feeling of autonomy, as individuals tend to feel more freedom when managing the app. Finally, elements such as rankings evoke a greater perception of relatedness with others, because players thereby can compare their performance with that of other users. These results are in line with previous studies in educational contexts and online brand communities (e.g. van Roy and Zaman, 2019; Xi and Hamari, 2019), where it has also been found that achievement-related game elements help individuals to feel more competent and autonomous and to interact with others.

Regarding the interaction with social-related game elements in apps (e.g. competition, social networks and cooperation), results have shown that these are predictors only of the satisfaction of the need for relatedness. We found they had no significant effect on the satisfaction of the needs for competence and autonomy. This result is in line with the study

Hypotheses	β	<i>t</i> -value	<i>p</i> -value
H1a: Achievement-related elements → Competence	0.307	3.00	0.001
H1b: Achievement-related elements → Autonomy	0.331	3.26	0.001
H1c: Achievement-related elements → Relatedness	0.263	3.23	0.001
H2a: Social-related elements → Competence	-0.141	1.14	0.127
H2b: Social-related elements → Autonomy	-0.140	1.30	0.097
H2c: Social-related elements → Relatedness	0.721	6.50	0.000
H3a: Immersion-related elements → Competence	0.344	2.64	0.004
H3b: Immersion-related elements → Autonomy	0.314	3.03	0.001
H3c: Immersion-related elements → Relatedness	-0.149	1.53	0.062
H4a: Competence → Autonomous motivation	0.002	0.02	0.493
H4b: Autonomy → Autonomous motivation	0.377	3.92	0.000
H4c: Relatedness → Autonomous motivation	0.162	1.77	0.038
<i>Control variables</i>			
App experience	-0.168	2.42	0.008
Weekly use of the app	0.072	0.80	0.210
Weekly exercise	-0.010	0.11	0.456
Gender	0.128	1.57	0.058
Age	0.103	1.30	0.096

Table 6.
Structural model results

carried out by Sailer *et al.* (2017), who also found that social-related game elements had a significant effect on the satisfaction of the need for relatedness. Previous research has shown that competition facilitates the sense of belonging to a group (van Roy and Zaman, 2019), cooperation encourages individuals to work together to achieve a common goal (Sailer *et al.*, 2017) and social networking features allow people to communicate with others. These social-related game elements are directly linked to relationships with other individuals. Hence, this might explain why they have an effect only on the satisfaction of the need for relatedness, and not on the other two needs.

The results of the present study also showed that individuals' interaction in apps with immersion-related elements (e.g. avatars and customization) facilitated the satisfaction of the basic needs for competence and autonomy. These results have corroborated others obtained in previous studies, which also found that sense of autonomy is enhanced by the individual's ability to create characters and avatars and to customize or personalize different aspects of the app (Kim *et al.*, 2015; Peng *et al.*, 2012), as they feel freer to make it their own. This category of game elements also facilitates competence, because users feel they control the app and are able to make these kinds of changes and customization. On the other hand, the results did not demonstrate that these game elements had an effect on the satisfaction of the need for relatedness. This may be because when users create their profile and customize their training, they set individual objectives that do not necessarily coincide with those of the community or encourage relationships with other players.

In line with self-determination theory, the results of the present study have shown that there is a positive relationship between the satisfaction of the basic psychological needs for autonomy and relatedness on individuals' autonomous motivation. Therefore, people will be more motivated to use the app and exercise when they feel a sense of freedom and can decide which activities and training they want to undertake while using the app. Furthermore, the support and assessment of other users of the app will be crucial for motivation. However, no significant relationship was found between the satisfaction of the need for competence and autonomous motivation. Hence, that individuals do not consider themselves very competent while using apps is not an impediment for them to be motivated to use them.

Lastly, regarding the control variables, the results showed that the length of time that individuals have been using the app negatively affects autonomous motivation to continue using it, because they perceive it as less fun and interesting than do users who have been using it for a shorter period of time. This could be explained by the "novelty effect," that is, that the effects derived from gamification reduce in the long term as players' initial curiosity about the game elements, which previously seemed original and motivating, diminishes (Hamari *et al.*, 2014; Hamari, 2017; Koivisto and Hamari, 2014).

The present study provides a number of theoretical contributions. First, previous studies have highlighted that gamification studies based on theoretical frameworks that seek to understand and explain the effects of gamification are still scarce (Hamari *et al.*, 2014; Seaborn and Fels, 2015; Johnson *et al.*, 2016; Matallaoui *et al.*, 2017; Sailer *et al.*, 2017). Therefore, the present study contributes to the literature by using a human motivation theory, self-determination theory, as a basis to analyze users' affective and attitudinal responses. Second, prior research has noticed that there is a lack of empirical evidence of the effectiveness of gamification in sports and health contexts (Edwards *et al.*, 2016; Johnson *et al.*, 2016; Sardi *et al.*, 2017; Koivisto and Hamari, 2019b). Hence, this research extends the existing gamification literature by offering empirical evidence about its effectiveness in the context of sport apps for mobile devices. Third, recent literature reviews have revealed the lack of knowledge about the effect of different game elements, as most studies are focused on analyzing gamification as a uniform concept (Johnson *et al.*, 2016; Sailer *et al.*, 2017). Therefore, this study contributes to the literature by analyzing the effect of three different categories of game element (achievement related, social related and immersion related) on

individuals' basic psychological needs. Fourth, prior studies have focused on analyzing individuals' behavioral outcomes, and not taken psychological variables, such as motivation, into account (Seaborn and Fels, 2015). Thus, this research extends gamification literature by focusing on users' gamification and its antecedents. Finally, another limitation of previous studies is their lack of validated scales (Matallaoui *et al.*, 2017). The present research, in contrast, offers an empirical study based on scales previously validated in the literature to measure individuals' perceptions of the variables of the proposed model.

The present study also provides a number of practical contributions for gamified app developers. The purpose of gamification is to integrate game design elements into non-game contexts to motivate people to behave in certain ways. Hence, understanding the determinants of motivation is important to successfully design and implement gamified apps. Based on the results obtained in this study, it can be concluded that individuals' autonomous motivation to use a gamified sport app is determined by the ability of the app to meet their basic psychological needs for autonomy and relatedness. To achieve a perception of autonomy, apps must include achievement-related game elements and immersion-related elements. These elements give app users a sense of freedom in decision-making, which ultimately is a major motivation to use the app. In this regard, it is recommendable that sport apps are designed in a way that allows users to see and save their results. For instance, apps can provide users with different options on trainings and challenges, and based on their performances, they can reward them with different medals. In order not to lose initial interest, these challenges should be designed using increasingly difficulty levels, so that users feel that their achievements are evolving. Likewise, app developers should include immersive elements within the app design, such as letting users create an avatar by choosing different aspects (e.g. shape of face, color and length of hair) so that the avatar physically resembles the user, and letting users customize the app (e.g. choosing an image for the wallpaper, designing bespoke trainings using exercises included in the app). On the other hand, as to the satisfaction of the need for relatedness, achievement-related game elements, such as rankings, also evoke a perception of relatedness. However, the game elements which have the greatest effect are social related. These types of game elements encourage app users to interact with others and allow them to feel part of the app community, which ultimately translates into a major motivation to use the app. To do so, first, it is recommendable to create an app community in which users can interact with other users by sharing their trainings, their walking and running tours or their recipes to eat healthier, among others. Once the community is created, sport apps should give users the opportunity to send invitations to their Facebook friends to join the app, as well as to share their achievements on Twitter, Facebook or the app community, so that their friends can see them, recognize their efforts with Likes and encourage them through motivating comments. To promote this sense of relatedness, users should also be able to compete and cooperate not only with their friends, but also with other members of the app community. To do so, app developers should consider the possibility of designing different challenges that require cooperation (e.g. a challenge in which users are required to invite app friends to join a team to complete a marathon considering the steps of all team members in one day) or foster competition (e.g. inviting friends to a competition on walking the most steps in one week). Finally, despite the fact that the present study did not confirm that satisfaction of the need for competence has a direct impact on autonomous motivation, if app developers want users to feel competent when using it, they should allow them to interact with achievement and immersion-related game elements. In short, the results of the present study allow us to identify which game elements of the app are associated with the satisfaction of the three types of need. Therefore, app developers and other entities can, in accordance with their strategies, focus on those that most interest them.

Finally, the present study has several limitations which offer avenues for future lines of research. First, the use of convenience and snowball sampling is a limitation of this study.

Future research should use probabilistic sampling methods to enhance the generalization of results. Likewise, increasing the sample size would allow the results to be generalized. For instance, future studies could try to contact with sport app developers to have access to all registered users. Second, only psychological variables have been analyzed in this study; other behavioral variables have not been considered. In this sense, it would be interesting for future research to adopt a complete and sequential influence of gamification on individuals' responses. Third, this study used cross-sectional data. Therefore, it has not been possible to analyze the effects of gamification on individuals in the long term. Taking this into account, it would be interesting to undertake longitudinal studies that will allow an analysis of the evolution of the effects of gamification over time and establish, thus, whether the initial motivation that arises as a consequence of the novelty of the apps is maintained or diminishes.

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